COMMITTEE WORKSHOP

BEFORE THE

CALIFORNIA ENERGY RESOURCES CONSERVATION

AND DEVELOPMENT COMMISSION

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In the Matter of:                    )
                                     )
Informational Proceeding and         )
Preparation of the 2005 Integrated   ) Docket No.
Energy Policy Report                 ) 04-IEP-01-H
                                     )
Re: Energy-Water Relationship        )
    Whitepaper                       )
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CALIFORNIA ENERGY COMMISSION

HEARING ROOM A

1516 NINTH STREET

SACRAMENTO, CALIFORNIA

FRIDAY, JANUARY 14, 2005

9:41 A.M.

Reported by:
Peter Petty
Contract No. 150-04-002

COMMISSIONERS PRESENT

John Geesman, Presiding Member

James Boyd, Associate Member

ADVISORS PRESENT

Melissa Jones

Michael Smith

STAFF and CONTRACTORS PRESENT

Kevin Kennedy

Matt Trask

Joe O'Hagan

David Abelson

Gary Klein

ALSO PRESENT

Paul Massera
California Department of Water Resources

Bill Forsythe
California Department of Water Resources

Lon House, Energy Advisor to
Association of California Water Agencies (ACWA)

Bob Wilkinson
University of California Santa Barbara

Gay Wolff
The Pacific Institute

Robin Newmark
Lawrence Livermore National Laboratory

Mary Ann Dickinson
California Urban Water Conservation Council
(CUWCC)

ALSO PRESENT

Robert Goldstein
Electric Power Research Institute (EPRI)

Matt Klein
Verdant Power

James R. Tischer
California State University Fresno

Stan Kaut
Santa Clara Valley Water District

Carsten Bethge
WorldWater & Power

David Erickson
Climate Protection Campaign

Anand Randarajan
WorldWater & Power (via teleconference)

Ed Mainland
Sustainable Novato

John Rosenblum
Rosenblum Environmental Engineering

# I N D E X

I N D E X

P R O C E E D I N G S

9:41 a.m.

PRESIDING MEMBER GEESMAN: Okay, we'll come to order. This is my second try at my introductory remarks. This is a workshop of the California Energy Commission's Integrated Energy Policy Report Committee. I'm John Geesman, the Committee's Presiding Member. To my left is Commissioner Jim Boyd, the Committee's Associate Member. To his left is Mike Smith, his Staff Advisor. To my right is Melissa Jones, my Staff Advisor.

The topic of the meeting is the interrelationships between energy policy consideration and water policy considerations. Rather than elaborate on those relationships right now, let me only state a caveat that I'd like to ask everyone to be aware of as we address this issue, both today and in future days when we revisit the question during our Integrated Energy Policy Report cycle, and that is that this is an energy forum.

We are going to focus our attention on the energy ramifications of our water system. This is not a water policy forum. And those of you that feel the temptation to relitigate or re-argue water policy questions, except as they relate to energy, are really well advised to direct your attention to some other water forum. I want to consistently try and bring us back to an energy focus.

I suspect both energy and water policy will be better informed by that energy focus, but we are an energy forum, and that will remain the focus of our attention.

Commissioner Boyd.

COMMISSIONER BOYD: Thank you. A couple of brief comments. I'm certainly glad to see this day arrive because since the Integrated Energy Policy Report, or IEPR as we call it, has been facilitating, and certainly is facilitating today, a look at system interactions -- in this case, as Commissioner Geesman has said, the interaction of energy and water -- this provides the ability to really take a good look at, as I said, the system involved.

And in preparing our 2005 Integrated Energy Policy Report, to expand and elaborate on other facets that we've been looking at since we first initiated this reporting process in 2003.

And as I said then, and continue to say, that the Integrated Energy Policy Report, and its annual updates and every-other-year total re-do, provides almost a continuing forum at this agency for looking at energy issues, but at their interaction with all other subjects. And therefore, as I like to say, looking at the system.

And since we're really into talking about sustainable development these days, I think that facilitates and fits into exactly what it is we're trying to do and what we'll talk about in today's workshop.

So, with that, I look forward to the proceeding. Thank you.

PRESIDING MEMBER GEESMAN: We've distributed an agenda which we'll try to faithfully follow. Kevin, do you want to describe the process that we'll go through for our energy report.

MR. KENNEDY: Yes. And I think I'll sit up here while the court reporter is working out the technical difficulties. I believe that you are picking up this mike, is that -- okay.

My name is Kevin Kennedy and I am the

overall manager for the Integrated Energy Policy Report process here at the Energy Commission in this cycle. And I want to welcome everyone here.

As part of the overall IEPR process we are taking on a wide range of energy-related policy issues aiming at adopting a final energy report at the end of -- or during the following November of 2005.

This water/energy relationship is one of many topics that we will be taking on. It is something that's very important. And in the particular effort here a lot of what we are focusing on is energy use within the water system, within the water sector.

And I just want to point out that there's a number of other efforts that are taking up some other aspects where there is some degree of interrelationship. As part of the overall staff effort, we are preparing two environmental performance reports for which we have had scoping workshops. I believe they were both in December if I'm remembering correctly.

One of them focusing on the electricity generation sector; one of them focusing on petroleum infrastructure in the state, particularly refineries, marine terminals, pipelines and storage terminals.

To the extent that we have concerns and issues around water use in those areas, particularly related to some degree, those issues will be picked up there, as well.  Also hydro issues, hydropower generation, and particularly some of the relationships of climate change are also being picked up in some other pieces.

So one of the great efforts as we're moving forward with the Integrated Energy Policy Report is to make sure that we manage to keep all of this integrated as we go forward.  But we'll be hearing a lot from Matt Trask, who is leading the effort for the Energy Commission on this project, and from folks from DWR, what we're focusing on in this particular portion of the effort.

Having said that I also would like to say welcome to the folks here in the room.  I know because we're taking on a water topic that in some ways is beyond the normal set of issues that we have traditionally picked up, I think we have a lot of folks who are less familiar with our building and our processes here.

I do want to emphasize for anyone

interested in making comments as we go forward, we do have a court reporter here today. And I think we at least are close to having the technical issues around that worked out. But I would encourage folks, when you have questions or comments, to be sure to identify yourself and who you're representing. It's also very useful for him, if you have a business card, if you can leave one with him as you talk.

Also just a few of the housekeeping details for those not familiar with the building. We do have a snack bar upstairs on the second floor, sort of straight ahead as you get to the top of the stairs, a little bit to the left.

Restrooms are available as you go out the main door here, sort of down the hall to the left. I would ask people not to go through the exit door there because it is alarmed. I'm sure at least twice today we will hear the alarm go off as somebody who doesn't have a key card to get out goes out. So just a few housekeeping details to keep in mind.

I would also like to welcome the folks who are listening in either on the webcast or on the conference call. For folks on the conference call in particular, I would like to remind folks that the conference call gets broadcast into Hearing Room A here. So if there's a lot of background noise, shuffling of papers, making lunch, and thinks like that, it can get very distracting. So to the extent that you can I encourage folks who are listening in that way to keep your phone on mute, if you have that possibility.

And the webcast is also a good way of listening in if you are simply listening. It also has the advantage that the slides and overheads that we see in the room are also available through the webcast.

So with those sort of housekeeping details and some degree of broadbrush introduction to where we're going with the Integrated Energy Policy Report overall, I'd like to hand it over to Matt Trask who, along with staff from DWR, are going to be sort of taking the lead on talking about where we're going with this particular part of the overall energy report proceeding.

MR. TRASK: Thanks, Kevin. I'm going to adjust the lights here so people can see the display a little bit better.

Like Kevin said, I'm Matt Trask; I'm the project manager of the water/energy relationship whitepaper. I'd like to take just real quick here to introduce my counterpart at the Department of Water Resources, Paul Massera here, with the Statewide Water Planning Office.

I'm going to talk briefly about some background; the purpose of the study; the scope of the study; and a little bit about what we know now, or at least what we think we know.

One of the key issues is that as we look more and more at these issues we're finding that there's quite a bit of missing data. We're finding that there's actually not a whole lot of data collection going on in this area. So that's one area that we hope to improve.

As the Commissioners mentioned, energy and water use are, of course, highly interrelated. The energy sector uses a lot of water, and the water sector uses a lot of energy.

The Energy Commission has identified this need to study the energy demand trends in the water sector. And the Department of Water Resources has identified a need to study the water demand in the energy sector.

About three weeks ago shortly before Christmas we met with the Department of Water Resources senior management and the decision was made to jointly conduct this study. One of the key things we want to do is make sure we're using consistent assumptions. Growth assumptions; things like how many gallons of water is pumped with a megawatt hour of electricity, things like that.

And then, of course, to prevent duplication of effort.

For the Energy Commission's portion, as the Commissioners said, we are focusing more on the energy side of the equation. We really want to be able to accurately assess the energy demand in the water sector. We know there's a lot of things coming up out there that could affect how much energy demand the water sector has. And we want to make sure that we have that fully accounted for so we can maintain good reserve generation margins in the state.

We want to also explore ways to reduce the onpeak and total electric demand of the water system. We can do that through many ways, through conservation, through efficiency, and to reduce the net use we can even squeeze some generation out of water systems here and there.

And then another goal that was sort of developed alongside with the white paper, and it may actually be sort of a separate product, is to further develop the tools and programs that the Energy Commission already has and the Department of Water Resources already has, to help out planners, water agencies, companies, literally anybody involved with water system infrastructure and energy system infrastructure, for that matter, to be able to address the energy needs of new and existing systems.

Our whitepaper, which will be published in late May, will be primarily informational in nature. It's to inform decisionmakers, general public and ourselves, the staff, about the critical issues in the relationship of water and energy. The more we look into these things, the connections we see, and some of them are not, I guess you could say they're counterintuitive.

As I mentioned we ar going to explore the present use in trends in energy use in all portions of the water cycle. And also I said the planning tools and programs will likely be a separate product.

Now this is sort of where we're starting from, what we think we know. We have determined that the water supply sector, which does include DWR's state water project pumping, uses about 11,953 gigawatt hours of electricity per year. Treatment is about 1388 gigawatt hours, and that's both pre- and post-treatment, getting up to potable water standards as well as wastewater treatment.

Now those two together are alone the equivalent of two 1000 megawatt power plants cranking out 24 hours a day, 365 days a year.

But end use is probably right about the same amount. This is, of course, the heating of the water, the pumping of the water, use of the water at the customer end.

Now, one of the things is that we can only estimate that. Nobody is recording exactly how much electricity any given water user uses. We can tell if you have a certain meter and you are classified as a certain customer we can tell how much electricity you use as that customer, but we have no idea whether it went to this pump, that pump, whatever. So one of the things we hope to do is to come to more of a realistic, less based on assumptions, calculation of the actual load in the water sector.

And I will note at the end of the notice for this workshop was a list of key questions. And one of those is also kind of addressing everything that we say here. Are we getting it right? Do we have these numbers right? Are there things we're not considering? So we want to hear back from you folks, both today and in written comments, about where we are, where we're going and how we should get there.

The other, of course, big demand in electricity is in irrigation. At least 2269 gigawatt hours of electricity goes just for irrigation. And what this map shows is, of course, it's concentrated in the agricultural areas of the Central Valley primarily.

Again, that is mostly an estimate. We do have a lot of information about how much a certain pump might be using electricity, but we don't correlate that with the amount of gallons that it's pumping. So we can, again, only estimate based on the electricity that certain meters are showing.

Now, as far as trends, of course we're seeing continued growth. This is going to put pressure on to find more and more new supplies for urban users. We're seeing a lot of changes in the water market, which we think are probably going to affect the transfer and conveyance patterns. Dr. Lon House will talk a little bit later about something we just heard about, a desalination proposal where the City of Las Vegas will pay the Metropolitan Water District to desalinate, and in exchange, take on a three-to-one ratio their Colorado River water. So they're willing to pay NWD three times as much to desalinate water just so they can take Colorado River water. Those kind of deals, I think, are going to be more and more coming forth, and they're really going to change the way the water is transferred around the state.

We're also aware of some Clean Water Act rules, section 316(a) and (b) primarily, that will affect intake structures, anything that's taking in water from a surface source, or from a seawater source, for that matter. We see that in the power industry, as well, for the once-through cooling systems. We think there's going to be some effect on the power industry, and we're just not sure about the water industry. So that's the kind of thing we're going to look at.

We also know that there's going to be more and more requirements for treatments of contaminants in groundwater and brackish aquifers as we treat those. And, of course, just about every day we hear about a new desalination power plant proposal. And we also hear about another water treatment plant going from secondary to tertiary treatment so that they can produce recycled water. All of those things we think will have an effect on energy and will likely increase energy use in the water sector.

Of course, we also have the climate change, what is going to be happening with the climate, and how is that going to affect water use patterns and energy use patterns.

We do have a separate study that's going along with the IEPR that both ourselves and the Department of Water Resources are participating in. It will go into our IEPR and into the DWR's water plan process.

We also have a separate study conducted by an office here called the Public Interest Energy Research Office, which sponsors a lot of programs, funds a lot of programs and studies. And they are doing one on climate change. And I'll talk a little bit more about that.

Now, of course, with climate change we could be heading for warming. That may mean more rain in some areas, but could be less snow. So that could have a big effect on hydroelectricity availability as well as water availability.

There's a recent study out that postulates that perhaps we're heading into a 500-year drought, or maybe a 1000-year drought. That perhaps the last 100 years were really extraordinarily wet in the course of history. So if we are heading into a drought, obviously were probably going to dramatically increase groundwater pumping and desalination.

Desalination, of course, could have a tremendous impact on energy use throughout the state. Right now there's two major types that we're looking at, the thermal multi-stage flash and the membrane-type reverse osmosis. About 90 percent of the desalination uses one of those two technologies. A few actually use both.

And, of course, there's many sources for possible desalination: ag runoff; brackish aquifers; of course, recycled water, wastewater, seawater and surface water. Primarily people are looking at seawater and the brackish water groundwater.

Like I said, 90 percent does come from multi-flash or osmosis. About 8.4 billion gallons produced in, I think that was -- yeah, 2002 at 13,600 plants worldwide. Sixteen percent of that was in U.S. at 300-some-odd plants. So obviously somewhat larger plants here in the U.S.

We do know that the energy demand for multi-stage flash is higher than reverse osmosis. Sometimes you can take advantage of thermal waste heat, such as in a power plant or an industrial process, that will lower the energy use of the flash system. But in general we know that RO is cheaper.

We do know the cost of seawater desalination is at least three to five times higher than that of brine water desalination. Of course, it depends on your TDS, total dissolved solid, in whatever you're trying to desalinate.

But we do also know that overall costs are declining, and in some cases rather dramatically. So we do expect to see quite a bit more desalination over the next ten years or so.

Energy consumption in desalination, of course, if a function of capacity, the feedwater quality, the amount of dissolved solids you have there; pretreatment, which is actually a very important step in the process and is actually the area that may be creating the most problems right now for a lot of people; and then, of course, the process and technology.

We give a range there of the energy use of several existing desalination plants. The MWD Orange County is a pilot project, and you see it uses quite a bit of energy per acrefoot. Tampa Bay Project, which people generally know a lot about, is the biggest one in the U.S., made by Poseidon. They are actually doing very brackish groundwater, so they're right about in the middle of energy use. And you can see down at like Chino Basin is actually fairly clean brackish water, if that makes any sense. So there is a very wide range in energy use for desalination.

Also a very wide range in energy use for the sources of water for water agencies. We can see we have a high of about 3500 kilowatt hours per acrefoot of water coming from the State

Water -- replenishment into the State Water Project, to a low of about 490 or 500 kilowatt hours for replenishing with recycled water, and then supplying with recycled water, as well.

This is a nice little step that kind of graphically shows where energy comes into the whole process. We start, of course, at our lake and then we head to the pumps that get the lake water to the treatment. There we use about 100 kilowatt hours per million gallons.

At the treatment center we use about 250 kilowatt hours per million gallons. And then we get that into the distribution system. This is where the energy really starts to step up, 1150 kilowatt hours per million gallons. That goes to the end user, which apparently is in, I think that's Myanmar; and, of course, there's a tremendous amount of energy used there.

And then we need to pump it back to the sewer system. We use about 150 kilowatt hours per million gallons for that. Then we treat the sewer wastewater and again pretty high use of 1050 kilowatt hours per million gallons. And we pump it back to the river.

Energy costs, I don't need to tell the

water professionals here, are a very high portion of the total operating cost for any treatment facility. For the pretreatment water -- water pretreatment it's at least 34 percent of the average treatment plant. And for wastewater it's 28 percent, right around 30 percent. Only staffing is higher.

So, what do we think is going to happen in the future. Obviously we're going to have more demand for water and that's going to be more demand for energy. We've got a growing population; we've got scarcity of water resources; we've got a lot of contaminants to deal with. We have increasing water quality requirements. And, of course, we have a lot of environmental concerns, as well. Many effects in the water sector, and that will in turn lead to many effects in the energy sector.

Well, what are the potential solutions to these potential shortages. Well, in the water conservation side there's all sorts of programs out there that we can reduce water. Almost all of them will also reduce energy, but there are some that actually would increase energy use. So we think that real careful planning is needed to insure that we don't really greatly increase the energy use in the water sector while we save water.

Another thing we're looking at is peak load reduction. If you looked at the generation profile in California any one day you start out at fairly low levels in the morning; power increases into the afternoon to very high levels, especially in hot summer days; and then trails down in the evening.

If we could water users to shift their intense energy use off of that peak into the evening, morning, night hours that could really prevent a lot of problems with the generation reserve margin.

We also think that there's perhaps ways to save energy by looking at some innovative market transactions, exchanges and so forth, that might prevent long-distance pumping.

And then another thing I need to mention briefly is perhaps we can squeeze some generation out of our water systems. Several ways to do that. Pretty much anywhere where you have a pressure relief valve or any sort of energy dissipation you could pop in a turbine right there and get some generation out of it.

There's some other types of hydrogeneration being proposed and developed. One of those is kind of a back-to-the-past with the paddlewheel-type turbines. We'll have somebody talking on that a little later today.

And then there's also increased interest in using the existing system of canals and reservoirs to create what we call pump storage where you could pump water up at night when electricity is relatively cheap and highly available. And then have it run down during the day to create power when you need it on that onpeak period.

Now, problems with water system generation. Quite often these pressure relief valves are located very far away from your pumps and whatever you need. Usually your pumps on one side of the hill and your pressure relief on the other side of the hill. So if you want to get your generation back to your pumps often that can be very difficult. So transmission access is probably the limitation there.

We have limited capacity, transmission capacity, in the state, so that may pose some challenge to get the power wheeled from one area to the other.

And then right now few purchasers are willing to sign contracts to buy this kind of energy. We think that will change over the next few years, but in those cases where a water system can see, well we could generate some water here -- or some power here, but we can't get it to our load, so we need to sell it. May have some hard times finding a buyer for that power.

Another part of this study, a very small part of the Energy Commission's study actually, but, of course, will be a much bigger part of the Department of Water Resources, is the water demand in the energy sector. And we will be doing some investigation in that to help out DWR. Perhaps some of that will end up in our white paper, but I think mostly will end up in the water process.

We'll be looking at water use in the refinery industry and the enhanced oil recovery. Enhanced oil recovery, for those not familiar with it, is where we take steam and inject it into the ground, heat up what is generally very thick crude oil in California to the point where it can be pumped and moved around. That does take a tremendous amount of water, but I believe most of it is used what they call process water, which is water that comes out of the ground with the oil and natural gas, wherever that's pumped. So we're not too sure how much fresh water is used there, but we'll be looking at that.

We'll also look at water use in thermal power plants. Right now natural gas power plants use a variety of water sources all over the state. And we'll be looking at ways of possibly reducing that.

A lot of changes coming in the electricity sector. We may be shifting more to what was called a distributed generation system where we'll have many smaller power plants rather than a few larger power plants. We flatly don't know what that will mean on water demand in the power sector, so we'll look at that.

And we're also probably going to be greatly increasing our renewable portfolio, all sorts of renewable generation all around the state. And, again, we're not too sure what that's going to mean on water demands. So we're going to be looking at that kind of thing.

We have quite a few resources already

within the Commission that have been looking at these kind of issues, sometimes for decades. One of those I mentioned earlier is the Public Interest Energy Research Office. We call it PIER.

They have all sorts of programs going on. One of them is the aquatic resources area, and they do quite a few programs there, their projects there. It is meant primarily to look at power plant cooling technology and alternative sources of cooling water.

You can see down there some of the things that they've looked into to address that issue. And you can also see that we have a conference on alternative cooling research scheduled for June 1st and 2nd this year in Sacramento.

In addition, PIER also has a couple of programs looking at end-use efficiency in the industrial and agricultural sector. Looking at improving energy efficiency of processing water for all types of uses. And it also has a technology transfer program to make sure that these RD&D developments get into the industry.

As I mentioned earlier, PIER also has a global climate change ongoing study going on. And they are looking at ways to mitigate and adapt strategies to the potential impacts that come from warming.

One of the key things that they will be doing is a statewide modeling effort of the long-term performance and management of the California water system. And that would, of course, feed into our energy system planning.

One of the things that -- another thing that PIER is doing is looking at how to improve runoff forecasting and the balancing between competing water demands. For instance, we are looking at a demonstration project to improve runoff and decisionmaking at four reservoirs, which you might actually be able to see up there, but they're all in northern California, Shasta, Trinity, Oroville and Whiskeytown is the other one.

And then lastly here I just have a list of several of the studies that the Energy Commission has been involved in, or task groups, things like that. I just throw those in there more as a reference for people's use. This one is probably too small to see, but this is a list of PIER reports in the water area.

And finally, I have a list of contacts there for folks that want to get ahold of myself to talk about the study. And then we have several sort of key contacts in different areas. If you need more information about desalination it's Shahid Chaudhry, who's actually on vacation right now, so if you call him today you may not get him.

We also have Gary Klein down for energy end use. Gary, are you here? Oh, okay. And then Joe O'Hagan, who is one of our PIER programs. Joe, do you want to raise your hand right there.

So that's it for our presentation. Again, I wanted to stress that we are here today to hear from you folks primarily, although there will be a lot of presentations. We hope that does spark discussions at the end of each presentation. And that we continually address these key questions which are on the back of the notice for this workshop.

So, I'll just throw it open right now if there are any questions on my presentation so far, which are focused on background, scope and what we know now. We'll have more general discussions later on.

All right, no questions. I'll turn it

over to Paul Massera to talk about DWR's half of the study.

MR. MASSERA: Well, as Matt mentioned, my name's Paul Massera and I'm with the statewide planning branch, Department of Water Resources. I'd first like to thank the Commission and Commission Staff for allowing us to participate in this activity. And frankly, we found it fairly simple to conceive of several potentially mutually beneficial alternatives in this collaboration. And that's kind of the thrust of my presentation here today.

Just a brief status on our water plan update process. As far as update 2004 I think I can safely say that we're looking at February of '05 actually, but still hoping for that spring 2005 release of the final plan. So we're just closing out the 2004 update basically.

Simultaneously, however, we're working on framework for the next update which is due out in 2008. And with that we're looking at a general approach, maybe developing some new evaluative tools, looking at some data gaps that we need to fill. We're also coordinating with CalFed.

And then perhaps most importantly for

this venue we are incorporating some global climate change considerations into our next process which is a first for the water plan update.

We were able to find three main components of the plan that have fairly obvious water/energy relationships. And what I'll do is I'll briefly describe each of these, and then go into a couple of general opportunities for collaboration that we were able to identify.

Starting with what we call the water portfolio, basically this tracks and records actual water use, so in retrospect, looking at prior years, what actual use did occur throughout all the sectors.

Then we actually have kind of a balancing process where we kind of reconcile that basically with the actual water supply to create a budget, if you will, where it usually resonates more with folks.

But frankly, there are data gaps in our portfolio. And we collected our data from basically the water districts and municipalities, and so we generally don't have good end-user data. And what I mean by that is we generally don't collect data involving water use in the energy sector.

We do have categories in our portfolio to plug that data in, but frankly we just don't or haven't collected it in the past. Which actually leads me to my next slide.

Coordination opportunity. We see the potential to leverage our data collection activities, and with specific regard to the water used for energy production.

Secondly, well, actually we do feel this data can help us estimate some of the current energy/water relationships with that actual data. And this will be differentiated with the future scenarios, which I'll get to in a moment.

Another product that's emerging with our update 2004 is we have included a draft narrative description, kind of a qualitative description. And it illustrates some of the fundamental relationships between energy and water. And we're hoping that we can glean some of your expertise on that, as well, before we go final with that.

I alluded to this a moment ago. The second component of the plan involves future scenarios which I understand the Commission is also interested in looking at, various future energy use scenarios. In our case these would be future water use scenarios.

Our planning horizon is 2030, but these represent a minimum of probably three demand levels we'll be looking at for the year 2030 with different scenarios. And what I mean by that is sort of described in the third bullet. We vary the demand levels based on things like population, agricultural, industrial, commercial activities. Basically all the key drivers that would affect water use.

And lastly, the reason why we're doing it is because it would provide a stead basis for future water supply and use to plug into our water management analysis, which is the third component that I'll get to in a moment.

Regarding future scenarios, two coordination opportunities jumped out at us. One would be to develop common scenario themes and descriptions. We have some -- we're kicking around some themes such as resource intensive, which might involve heavier water use in most of the sectors versus maybe a current trend, which is -- well, that one speaks for itself. But those types of themes and descriptions we would hope to be able to be on the same page to develop some interagency consistencies.

Secondly, we're thinking perhaps a partnership and a pooling of resources to actually go in and quantitatively assess these relationships. That would be basically quantifying, basically estimating demand for 2030 in our case in a quantitative fashion.

We feel that has a potential to provide consistency with our methods, our assumptions, our data, and maybe most importantly, our reporting of the results.

Water management analysis, that's the third and last component of the water plan where we saw a clear nexus between water and energy. And just so we're all on the same page, I've provided a description definition of what I mean by water management alternative.

This is actually describing the analysis, itself. It pertains to prior updates and it also pertains to what we hope to do for 2008 in a nutshell. We want to estimate the costs and the benefits and the impacts and other tradeoffs that would result from implementing various water management alternatives that we have at our disposal in terms of the water management community.

And what we hope to produce basically is results that can answer these policymakers' questions so they can do their thing and make their decisions on what to implement in the way of policies and actions.

We also aspire to standardize our output across all alternatives. That is the water supply from one alternative would be -- basically to bring it into apples and apples, for instance.

Thirdly, and perhaps most importantly, we want to continue to address all significant considerations in our process. And that would include energy, environmental considerations, economic, and of course, the more basic water supply, water quality, those types of considerations. And I will elaborate on that in just one moment.

What I wanted to do here in slide ten is just give you a list of the types of water management alternatives that we've kind of got on the table. We, through an exhaustive process with our stakeholders, identified several alternatives.

I'm not showing you this to familiarize you with all of these alternatives, these 20-some-odd water management alternatives.

What I'd rather just impress upon you with this slide is the number of alternatives. And also the diversity of the alternatives. And you'll see how this plays into my point in just one moment.

To start with I might point out that each of these alternatives has the potential to affect energy. In most cases directly, and in some cases indirectly.

And that brings me to kind of a flag, a challenge that DWR identified in this activity. We have challenge and then a potential resolution to the challenge.

I think I'm going to state the obvious here with this first bullet, perhaps understate the obvious, that the relationships are complex. Sometimes they can be reciprocating, counter-intuitive, and even sometimes unidentifiable, at least at a high level. And I'll explain what I mean by a high level in a moment.

And perhaps more importantly each of these alternatives can not only affect energy, each of them can affect energy in both a positive and a negative manner. That's where some of the complexity comes into our process.

And it's depending on several variables such as location, such as how a specific project is operated, specific actions within an alternative. Matt alluded to water use efficiency, for instance. There are some actions that can decrease energy use; some that can increase energy use.

I think another obvious example would be surface storage. That has a potential to -- whether it's onstream, offstream, where the water's delivered to the end user. All of that can affect the net effect of energy use on production. I'm just pointing out a few complexities that we are facing.

One way that we tried to frame this activity and add structure to it -- I apologize for the handout that you can't see them. It might be best to try to look on the screen.

We took the water management strategies that I showed you and we put them on the left column here of this matrix. Then with our stakeholders we identified several water management objectives. And you can see those across the top of the matrix. And one, not the least of which, is energy.

Frankly, we had a little trouble checking out these boxes and drawing these direct correlations for the reasons that I mentioned. Things are project-specific; they're location-specific. In fact, the tendency was to just draw a check in every single box, because everything is related to everything.

What we did to try to address those complexities is develop kind of a structured objective analytical framework. And that's what this next table on slide 13 represents.

Working with our stakeholders we identified several basically matters of importance to the stakeholder community, and we called them evaluation criteria.

And as you can see we've certainly incorporated energy-related impacts in terms of production and consumption. And that would include the whole gamut that Matt Trask mentioned in his prior presentation in terms of conveyance, treatment, disposal, end user.

So this is basically how we expect to

plug in energy considerations into our water plan process. And this is another area where we hope to gain a lot of benefit from collaborating with the Energy Commission.

And with regard to the analysis, the most obvious opportunity would be to collaboratively look at, analyze and quantify these water management alternatives, specifically the energy components that the Commission would be interested in.

Also perhaps there's possibility to look at some cross-resource policymaking options. And what I mean by that is consider maybe water and energy incentives to implement water management alternatives that may provide mutual benefits that we, both Matt and I, had already touched on a couple of examples of that.

And lastly, just to provide a summary of our thoughts on where we may collaborate, or may be able to collaborate with respect to each of the components of the plan. And I won't walk you through those again. Just wanted to close with a summary.

Thank you very much.

PRESIDING MEMBER GEESMAN: Paul, I want

to thank you very much for your assistance with us on this. And I would strongly encourage you to have your staff develop, with our staff, some pretty specific proposals as to how to jointly pursue some of this analysis.

I think you'd find our Commissioners extremely receptive to devoting whatever resources were appropriate to assist that analytic effort.

I'd also suggest to you, and you know, this is probably principally directed to our staff, but I'd ask you guys to take it into account as well, to look at a time dimension and seasonality dimension. We tend to contribute, I think to a little bit of a misleading impression, when speaking solely about energy.

One of our principal policy challenges is dealing with peak demand. And I suspect one of the principal opportunities here, both on the demand side and on the supply side, is better addressing ways in which we can approach meeting peak demand. Whether it be shifting demand from the water system to offpeak periods and trying to assure ourselves that we've optimized our efforts for that. Or using the water system from a supply standpoint as ways in which existing infrastructure can contribute to supplies that would meet that peak demand. Or perhaps re-engineered infrastructure can make that contribution.

MR. MASSERA: Great. Yes, I would point out that one of the water management strategies we have is re-operation of existing facilities, and that would be something we'd be interested in.

PRESIDING MEMBER GEESMAN: I certainly appreciate your contribution and that of your staff. Thanks very much.

MR. MASSERA: Thank you.

COMMISSIONER BOYD: Paul, a couple of comments. We have to share a mike here to override the technical deficiency.

One, I want to also commend you on your presentation. I want to commend you in particular on your coordination opportunities. I found myself putting big stars next to both of those as something obviously our two agencies want to work on. And I thought you certainly touched on very key points.

Your laundry list of water management alternative analyses, I know that economic incentives, which is something that interests us here in this agency, and it's fairly common in dealing with the kinds of issues that our agencies mutually deal with.

You mentioned loans and grants. And in previous lives I've been associated with both DWR and the Resources Agency, and was very familiar with some of the loan and grant programs. And I know you gather a lot of data about -- they're basically water efficiency loans or grants, I guess, and you gather a lot of data about the water efficiency results thereof.

And I'm just wondering if we also capture, or could capture energy efficiency data if there's synergisms involved in those kinds of programs in the future.

MR. MASSERA: I think that's definitely a possibility. That would be -- I'm not certain whether or not that particular parameter is a consideration in the current framework for distributing these and evaluating them. But certain would be a possibility.

COMMISSIONER BOYD: Thank you. And lastly, your slide 11 on water management alternative analyses, you very appropriately pointed out how water management alternatives can create desirable or undesirable energy impacts. And I think we could put blank spaces in some of those and talk about how for every action there's a reaction somewhere else; and there's always the law of unintended consequences. And I guess it's a society where we're getting sophisticated enough now finally to begin to recognize that and deal with that.

And again, I commend you for pointing that out because it's certainly been left out of most of what we've done. And that's a general generic we, not our two agencies, over time. So, the good part of looking at total system consequences is you get a better handle on things. The hard part is you've got to recognize unintended consequences or what-have-you and deal with them. And that makes it tougher.

But, you know, we no longer can look at our little narrow pieces of the whole pie and deal with them. So, a very good presentation and I, for one, along with Commissioner Geesman, are very encouraged and look forward to our two agencies working together. Thank you.

MR. MASSERA: Thank you, likewise.

MR. TRASK: We might pause here to take,

if the audience has any general questions about Paul's presentation. Otherwise we'll move on to Bill Forsythe on the State Water Project.

Okay, you need to come up to the microphone to ask a question.

MR. TISCHER: Jim Tischer, Center For Irrigation Technology, CSU Fresno. Excellent report. You know, the meshing between the two agencies is well done.

The generic question I would ask is the third dot on the water/energy connection would be the air quality. And I would be interested in your observations or how that will fit into the mix. We see it on the diesel side, but, you know, 500 or 1000 megawatt combined cycle plants to handle the transferred water to southern California has a major impact on air quality.

How will you fit that into your matrix, please? Thank you.

MR. MASSERA: Yes, certainly. We have discussed with our stakeholders, when I showed you that list of evaluation criteria it is a draft list. And it includes several types of environmental impacts, mostly related to water management.

But where exactly we draw that line is still not necessarily established. And it will probably be a function of our next advisory committee for the 2008 update. And I'm certain that that would be a talking point when we actually finalize these criteria for the analysis.

And I understand there are tools emerging that enable us to look at that in a quantitative fashion, and those will certainly be a consideration, as well.

COMMISSIONER BOYD: I think the last gentleman's comment about the air quality is very relevant -- at this agency we've talked a lot about interaction of energy and the environment, energy and air quality, in particular.

And in our earlier talking about this system (inaudible).

MR. O'HAGAN: My name is Joe O'Hagan and I'm in the PIER program. I just wanted to mention that the PIER environmental area had funded a study by the Pacific Institute that prepared a simple spreadsheet model for water managers to take a look at your different alternatives.

And from that you could calculate what, because of the electricity requirements, the air quality impacts would be in terms of emissions. So if anybody's interested in that I can give them more information.

Thank you.

COMMISSIONER BOYD: Good point, Joe. And I just wanted to -- this is a workshop, this is not a hearing. So the value of workshops is the exchanges of information. That various entities are involved and affect the others (inaudible) who to contact and who to deal with in the future, so I appreciate all these comments (inaudible) this is a workshop to try to advance the art and the science that we're dealing with.

MR. TRASK: Thank you, Commissioner. One thing I might do is at the end of our presentations here I might spend a brief time on our website to show where some of these resources are available, including the spreadsheets that Joe just talked about.

Now we'd like to move on to a presentation about the State Water Project and its energy use, which is by Bill Forsythe.

MR. FORSYTHE: Good morning, Commissioners and audience. My name is Bill Forsythe; I'm an engineer with the California

Department of Water Resources. In my present capacity I serve as assistant to the Deputy Director over the State Water Project.

Just to kind of give you an overview of what I'm going to talk about today, I was planning to talk about the history of the State Water Project; the mission of the Department of Water Resources; and more specifically, how that fits in with the State Water Project. And also to give an overview of the State Water Project operations and some of the energy issues that we have.

California has a few major projects. The Central Valley Project is shown here in yellow. It's primarily an agricultural project; the major facilities are Shasta Reservoir and Folsom Reservoir.

The State Water Project is shown here in red. This is Oroville. This is the primary supply for the State Water Project. We have the North Bay Aqueduct which serves the Napa area and the north San Francisco Bay area.

MR. TRASK: Sorry for the interruption. We have somebody on the teleconference that's giving a lot of noise into the hearing room here. Hello?

(Laughter.)

MR. TRASK: Maybe you could sing us a song?

(Laughter.)

MR. TRASK: All right, just a reminder to all those folks on the teleconference, any background noise is being broadcast into the hearing room and onto the internet.

MR. FORSYTHE: Thank you. To continue, the State Water Project here is shown in red. I won't talk about some of the other projects, but the key feature of the State Water Project is it really is the heart of the state water system. And it provides some level of redundancy to other local projects.

The history of the State Water Project. After World War II the population growth in California. In 1957, at that time it was the Division of Water Resources, put out the first California water plan that showed the need for additional projects to meet the increasing population in California.

In 1960 the voters approved an approximately $2 billion bond which helped finance the original SWP facilities. To date, we've spent about $10 billion on the initial construction, ongoing operations and maintenance of the project. The initial facilities were completed in '73, but since that time we've increased the capacity of certain facilities and built out other reaches that were not constructed in the early '70s.

The State Water Project was planned, designed and built by DWR. And the SWP is the largest multipurpose water project in the United States.

As far as the purpose of the project, California's water supply varies seasonally. Most of the water sources in California lie north of the San Francisco Bay, while most of the people and most of the water users lie south of Sacramento. So about 80 percent of the demand in the state is in the southern part of the state.

The mission of the Department, the overall mission is to manage the water resources in California in cooperation with other agencies to benefit the state's people and to protect, restore and enhance the natural and human environments.

Within that mission the state has the goal for the State Water Project is to plan, design, construct, operate and maintain the project to supply good quality of water for municipal, industrial and agricultural and recreational uses.

One key thing about that is if you'll notice, our objective is water; it's not power. Power just enables us to meet our water mission.

Some of the specific strategies, and by the way, this information is available on the DWR website if you want to get more detailed information on what these strategies are. But from the State Water Project perspective we assess the reliability of the water supply.

Some of the efforts we have in that area are we do snow surveys; we forecast what the available water will be in the system. We plan for SWP augmentation of supply. That's primarily done through facilitating water transfers among our various contractors.

We design and construct new facilities and make modifications as necessary. We recently completed an extension of our east branch which serves the eastern portions of southern California. And we have a project that's going to go to construction later this year which one of the Commissioners pointed out the idea of trying to minimize our onpeak energy. It's a project that's meant to accomplish just that.

We operate and maintain the State Water Project with maximum flexibility and reliability. One of the constraints which I'll get to later on in this presentation is when we can actually move water in the system. And so we need to have our infrastructure capable of taking full advantage of those opportunities to capture and move water.

We comply with all regulatory standards; that's environmental standards, water quality standards. And we manage the SWP to sound economic and best business practices to try to provide an economical product to our customers, the state water contractors.

As far as an overview of the State Water Project there's 29 water contractors. That water serves approximately 900,000 acres of agriculture in the Central Valley. Approximately 20 million people get a portion or all of their water from the State Water Project.

As far as the deliveries of the project, we have in the original state water contracts and subsequent amendments, we have what's called table

A. Table A is what allocates water to the various contractors.

In the supply contracts we have 4.2 million acrefeet of water allocated. But average supply that's available in the system each year is around 3 million acrefeet.

The distribution of water is approximately 50/50 between agricultural and urban uses.

As far as the SWP facilities we have approximately 30 storage facilities. We have 29 pumping and generating plants. And nearly 700 miles of canal and pipeline.

The original financing for the project was the general fund financing initial allocation to construct the project. The 29 water contractors, they service those bonds every year. The Department bills the contractors for that bond service and all the ongoing operations and maintenance of the project.

So this is just the map that I had previously, just showing the -- pulling out the other water projects and just really showing the state project.

Here's a profile of the State Water

Project. As you can see up here on the left side of the page, this is Oroville. This is the supply for the State Water Project. This facility at Oroville, we recover energies, we make releases out of Oroville and at the Thermalito diversion dam and afterbay.

After it leaves those facilities it enters into the Feather River and then into the Sacramento River system. And then we capture the water down in the Delta, down at the Banks Pumping Plant.

From the Banks Pumping Plant it continues down the system as we turn out to various contractors along the way, making deliveries.

Something that I should point out here that gets to more of a power issue is we have what's called the Valley string pumping plants, which is the Buena Vista Pumping Plant, Teerink, Chrisman and Edmonston Pumping Plants. And that series of pumping plants, we call it the Valley string because the pumping plants are set up with matching units, so we can turn on a string of units. Meaning that we would turn on say five units at Edmonston, five units at Chrisman and so on.

This right here is a major power bottleneck for the State Water Project in that there's no storage in between these facilities. So when we turn all these pumping plants on we represent over 1000 megawatts of load on the state grid. Which on a day of say, I'm not sure what today's load is, but let's say an average day, that could be upwards of 2 to 3 percent of the whole grid when those plants are on.

Something else to point out here is as we get over the hill here at the Tehachapis, we have a series of generating facilities. We try to capture as much of the energy in the system, try to recover as much of that as we can.

As far as the deliveries go, with the existing facilities I mentioned earlier that the average allocation is about 3 million acrefeet. The capacity of the system matches what the original contractual amount was, which is about 4.2 million acrefeet.

The State Water Project is the single largest power consumer in California. We have an installed pumping capacity of about 2.6 gigawatts. The highest peak load that we've ever encountered was 2.2 gigawatts. We also happen to be the fourth largest generator of power in California. We have an installed capacity of about 1.5 gigawatts.

As far as how we operate, the major water supply is Oroville Reservoir. As far as how we operate at Oroville, we have a very sizable generating plant there, but our primary purpose there is to preserve the water supply. That's the water that we're going to be delivering to our contractors.

So within the constraints that we're under, our first objective there is flood control. This is a facility that's regulated by the Corps of Engineers so we must follow their storage guidelines to keep the facility safe, to protect against floods.

We have to make releases for environmental purposes, to maintain water quality downstream. We have to make temperature releases to help out with fisheries. So, within the operative constraints we release water from Oroville and then we try to capture it as best as we can in the Delta.

And just to point out again, the power

generation in Oroville is really an ancillary benefit that we get, but our primary objective there is to preserve water supply and to meet environmental and fishery needs.

South of the Delta we have a lot of issues in the Delta with being able to capture water. So as far as trying to minimize our onpeak pumping, from a water supply perspective we have a lot of fishery and water quality issues in the Delta that really dictates when we can pump. So we take advantage as much as we can of offpeak pumping, but occasionally we have to utilize peak pumping.

And further south in the Delta, as I said, we like to take advantage of as many recovery opportunities as we can to recover as much power as we can in the system.

As far as the balance of energy, the State Water Project, in wet years we have a much closer balance between the pumping loads and our energy resources. But in dry years, as Paul pointed out the water plan, and one of the purposes of the State Water Project is to provide a reliable water supply to our contractors. And our contractors have been getting into more and more water transfers where they try to maintain a consistent supply in the system to meet their needs.

So, in very dry years the State Water Project wheels a lot of water that we don't necessarily have the generating resources for since this water doesn't originate from Oroville. So we have a little more challenging time in dry years to try to find adequate resources to move the water.

As I pointed out before the mission of the Department is to provide good quality water. Energy is not part of our mission, but it does enable us to deliver water. The SWP contractors pay for all the costs associated with delivering that water, so their incentive is to try to coordinate their demand and the deliveries they need to minimize the onpeak power that's required.

I had something else that I wanted to kind of point out before I get into questions, just to kind of put into perspective, Matt had talked about desalinization. About approximately 8.5 billion gallons of desalinization is done globally each year.

That works out to be, I did a rough

calculation, that's about 25,000 acrefeet. So that represents, from what the State Water Project delivers to our customers, that represents approximately .9 percent globally, the desal is about .9 percent of the water we deliver every year on average. And the statistic he had on the U.S. desal, that would represent about .1 percent, .15 percent of the total State Water Project deliveries. So, just to kind of put into perspective of how much water it is we move. We have, in fact, pumping plants that would move the total global desal in about a day.

So, if there's any questions?

PRESIDING MEMBER GEESMAN: I apologize for a little bit of a Rip Van Winkle question, but when I was involved here in the '70s, I think that the Department had an exchange agreement for output of Oroville with the Southern California Edison Company. Do you still have a similar type of agreement?

MR. FORSYTHE: That's a good question. Actually, we don't. That agreement expired a couple weeks ago.

PRESIDING MEMBER GEESMAN: Oh. Let me ask then, how does the accounting work for power output within your system? Do you attach a different time value to onpeak generation than you do to offpeak generation?

MR. FORSYTHE: I'm not sure exactly, is your question -- well, we pay for power and all those costs get allocated to our contractors. Are you -- is the question how do they get allocated, like to specific contractors?

PRESIDING MEMBER GEESMAN: Well, are they all internalized within the system? You're not conducting external sales of power to private purchasers, are you?

MR. FORSYTHE: I believe we do. You know, we have a lot of power resources in northern California. We have a lot of power load in southern California. So we buy in the various zones where --

PRESIDING MEMBER GEESMAN: Okay.

MR. FORSYTHE: -- we need power and we sell power in the various zones where we have power. We do route some of our own power through transmission facilities throughout the state, but in essence, --

PRESIDING MEMBER GEESMAN: Okay.

MR. FORSYTHE: -- it's a combination of

the two, if that's --

PRESIDING MEMBER GEESMAN: Okay. Then if you generate an extra dollar in your electricity allocations, that presumably then flows through your accounts to reduce the obligation of your contractors for debt service?

MR. FORSYTHE: That's true. The annual -- well, not debt service, but the bill that the contractors get, they get a portion of the bill goes to debt service, a portion of the bill goes to the various operations, annual operations. So it would go to them under their variable energy portion of their bill.

PRESIDING MEMBER GEESMAN: So they're the entities then that have the true economic incentive to see that you get the best price you possibly can for your generation output?

MR. FORSYTHE: That's correct.

PRESIDING MEMBER GEESMAN: And similarly, that you operate the system in such as way as to minimize your generation costs?

MR. FORSYTHE: Yes.

PRESIDING MEMBER GEESMAN: Okay, thank you.

COMMISSIONER BOYD: A couple of

comments, if I might, and maybe a chance to throw a bouquet to DWR in this public forum.

During the electricity crisis I spent quite a bit of time interacting with the Department of Water Resources. First with regard to looking at the issues of efficiency, of generation, that is had they maximized -- optimized, not maximized, an upgraded their generating facilities over time to take advantage of new technology, to squeeze all we could out of the system. And I was impressed that indeed, that had been done.

And secondly, during the darkest depths of the crisis it was always DWR who turned off the water project, in effect, first before we went out to the general public to, you know, start rolling grey-outs, if not blackouts. And DWR was always there helping during that crisis. In fact, even before it went public as a crisis, DWR was buying and selling chunks of electricity to try to help to keep the system up.

And you and Commissioner Geesman had a brief discussion of the buying and selling of electricity. And, of course, I'm very aware it was because of your 30 years of experience of buying and selling electricity that you got drafted into saving the state. When we came within two days of no more credit to the utilities, DWR was called upon and told you're going to have to buy and sell electricity for the entire State of California.

So even though you get a lot of grief over those alleged DWR contracts, I just want to publicly commend the Department for the job that it did. Because you virtually had to set up folding tables and computers and go, as I've always said in other forums, from the A league to the major leagues overnight. And, you know, it's kind of like you're going to play the Yankees today and you have to beat them, or the fate of mankind is at --

So, actually the Department did a very commendable job during that time. And the price of electricity had to be hammered down, and buying contracts is one way to do it. The trouble is it got hammered down right past the low price that was being offered at that time. And so you have been saddled with that issue over time.

But this is not the forum for that, but I thought I would say that anyway.

And, again, just, you know, the two agencies continue to look forward to working closely together on all these issues. And I appreciate your input today, and appreciate what the Department has done over the past several years. And I think we can even do more in the future. So, thank you.

MR. FORSYTHE: Thank you for the kind words, Commissioner. Just to take your analogy one step further, we operate on an Oakland A's budget, but we do compete against the Yankees every day.

(Laughter.)

MR. KAUT: I had a comment.

MR. FORSYTHE: Sure.

PRESIDING MEMBER GEESMAN: You need to come up to a microphone.

MR. KAUT: Can't hear me?

PRESIDING MEMBER GEESMAN: Well, we can hear you, but we're very meticulous about maintaining our transcript, so you need to make certain that the green light is on on your microphone, then identify yourself so that we'll catch your name on the transcript of the hearing.

COMMISSIONER BOYD: And the people out

there in radioland can't hear you unless you speak in a microphone.

MR. KAUT: Good points. I'm Stan Kaut. I'm a manager with the Santa Clara Valley Water District. We're both a water agency and we use power. And there was a couple profound points that I just had to make some comments on, myself.

When I came to the meeting I was noticing that it was power and water. And I was surprised early on to see the discussion of the desalinization like kind of the high point of some of the things we're going to talk about today.

And it brought it home to me that I wasn't that far off when I heard that it was about .1 percent of the amount of water that DWR moves around.

I was also thinking about the Santa Clara Valley Water District had a couple of distributed generation projects this last year. And we're real proud of those. One of those is in solar, and I haven't heard solar mentioned today. I've heard very little mention about distributed generation. That's a real big deal; that's a real big opportunity for agencies like ourselves to contribute.

And I also heard the comment about air pollution, air quality, and was thinking about a couple years ago during the crisis we were able to contribute to the crisis by pulling load off the grid by using our diesel generators for short periods of time, very minimal impact on the environment. But that was taken away from us when we can't use the diesel generators any longer as emergency resources.

So as we move ahead I'm not sure what my role is going to be in this process. But I'm kind of seeing a gap between us, as water agencies and having to use energy and having to manage our costs and everything with energy, and what we're getting from this process so far. There's a gap for me.

Also I notice that both in our mission and the mission of DWR, the word energy is not in there. So to encourage us, I think, since our main purpose is water treatment, water supply, things like incentives are important. I heard water incentives before, but our incentives to do the solar and the distributed generation, we're doing a cogen project, was the financial part. That helps reduce our customers' cost for their water, because we'll eventually will be off the grid and will be supplying our own power. And it will be cheaper than the power we can get from the grid.

So I'll give you my comments as we move ahead on the different things. I just wanted to let you know from my perspective right now there's a little bit of a gap from a water agency, and where this workshop's going so far.

Thank you.

PRESIDING MEMBER GEESMAN: Thank you. And I just want to make certain I understood you correctly. You currently internally utilize all of your generation from the distributed generation project?

MR. KAUT: Correct. We have a -- we did it at our headquarters facility. We put in a carport with solar panels on top of it. We put a rooftop with solar panels on it. And we're completing a cogen project that will use a natural gas generator and the decay heat will help take care of our HVAC.

That combined project will basically take us off the PG&E grid, and we will not be generating in addition.

And we originally measured the CEC's offer and the CPUC's offer, and we switched over to the CPUC because there was more money in there for the District and their customers.

PRESIDING MEMBER GEESMAN: This was the incentives for solar?

MR. KAUT: Correct, yeah.

PRESIDING MEMBER GEESMAN: Okay. Thank you. I encourage you to stay tuned, because this is very early, not only in today's process, but also in the 2005 cycle that we're following.

We're going to visit a number of these issues over the course of the next six or eight months.

MR. TRASK: Maybe just one more plea to whoever is on the phone there, we have one person we keep hearing a lot of noise from. So, folks on the phone, if you could take extra care of that, thanks.

And I have just one quick thing about desalination. It's true it's a very small portion of the water supply right now. And it is, especially compared to pumping. But we know a lot about pumping, and we have that well accounted for in our resource planning.

We're worried about that next increment, what is going to be increasing energy use. And for that we do see desalination as a pretty major potential contributor to energy demand.

MR. ABELSON: Thank you. My name is David Abelson; I work here at the Energy Commission serving as legal counsel, among other things, to the IEPR.

Just a quick question, Mr. Forsythe. There was a suggestion a bit earlier by Commissioner Geesman that users of State Water Project water would have a considerable interest in reducing the amount of energy demand of the system because it would save them money, and perhaps increasing the output from the system in some way, because it may also save them money.

And I guess my question was as part of the operations budget, to the extent you can generalize, because I assume every contractor is different, is the energy item a large percentage of that budget? Is it a small percentage of that budget? Is it something people would care a great deal about, or perhaps not, because it's not a great percentage of their budget?

MR. FORSYTHE: That's a good question.

The single largest, that Valley string of pumps, which represents about approximately a gigawatt when that string's running, the whole capacity is up, the primary customer for that water is anybody that's over the Tehachapis, which is primarily Metropolitan Water District of Los Angeles. That also happens to be our largest customer.

So, you have a single customer of the 29 that has a very large incentive to try to reduce the power costs, try to push as much pumping as possible to the offpeak.

And something that I briefly just kind of -- I mentioned we had a construction project that was about to start in the next few months. It's actually a project that's just over the hill from those pumping plants. And the intent of that project is to try to give us more flexibility to get off of that peak.

And our problem is we have a certain capacity downstream of that, and by not having -- having such a large reach of aqueduct with no storage, it forces us to try to -- to push some operations into the peak.

So this project that we have is going to construct a small reservoir that will let us shut off the pumps sooner to try to stay out of the peak, but to still maintain the capacity of those facilities to be able to make our deliveries and meet the demands of our customers.

There's a very big price incentive out there for us to seek out projects that save power, allow us to shift, give us more flexibility.

PRESIDING MEMBER GEESMAN: I guess that raises the reciprocal question, though, on my part, because energy is not a core part of your statutory mission, is there a comparable incentive to invest in projects that would maximize your power revenues?

MR. FORSYTHE: That's a good question. I don't think I'm the right person to answer that. But we, you know, our core business is water delivery. Our primary facilities are all water facilities. We try to recover as much power within our water system. But as far as opportunities outside of our water system, back in I believe it was the '70s, we had a small investment -- a very -- from the contractors' perspective, a very sizable investment -- in a plant --

PRESIDING MEMBER GEESMAN: The

geothermal plant?

MR. FORSYTHE: -- the geothermal plant that proved to not -- it wasn't a very good investment. But, so, you know, we have looked at other opportunities outside of our water system. But, --

PRESIDING MEMBER GEESMAN: Let me confine my question to inside the water system and hypothesize, have you maximized pump storage opportunities on the downslope of the Tehachapis?

MR. FORSYTHE: I would say that's probably yes. In the State of California about every good reservoir site there is has already been built on. Most of the sites that are being, in fact there's an actual place called Sites that a reservoir is being explored. And that's a facility that's very far from the Sacramento River. It would be very power intensive to store water there.

That might add some flexibility to provide some peaking opportunities, but as far as good reservoir sites, I don't think the environmental regulations, the -- it would be very hard to site a plant in a place that would provide some good power opportunities today.

PRESIDING MEMBER GEESMAN: Thank you.

COMMISSIONER BOYD: Let me explore this issue a little further with you, but maybe change the question around. And confess that I worked for eight years at the Department of Water Resources.

My understanding, my recollection is that, Commissioner Geesman, because the project is power deficient that there always was a concern and an interest in trying to squeeze all the power out of the facility that could possibly be squeezed, because they have to buy power in very large quantities.

It's been a long time since I was there, but there always was a keen interest in that issue of the power deficiency. And I believe Pyramid Reservoir was built several years after the project was initially running in an effort to not only have another water storage facility, but up there in the Tehachapis to take advantage of the opportunity to generate even more power out of the system.

I'm hopeful the Department's obviously still looking at squeezing everything they can out of it. Sounds like they have. But it was my experience that they were very cognizant of that issue because it is a cost issue, and the issue of, you know, every inch that water moved it costs a little bit more to whoever is downstream at that point, because they accrue the costs of delivering the water up to that little point.

And I do remember the water contractors not only looking over your shoulder, sitting on your back, literally, at every cost that was incurred. And looking hopefully at opportunities to do things. Hopefully that's still the mantra of the Department. But just a little personal reflection.

PRESIDING MEMBER GEESMAN: Yeah, I would suspect that it is the mantra of the Department. At the same time, the investment banker in me suggests that since our rate system does such a good job of concealing the true cost of peak power, if you could get to a more transparent view on what those costs were, the state might be able to figure out some way in which to translate that into a revenue opportunity for the Water Project, which might open up the opportunity for more projects.

COMMISSIONER BOYD: Very good point.

This is Commissioner Boyd. I want to join Mr. Trask in his constant appeals to the public out there listening on the conference call to please watch the noises you make. Somebody out there for the last hour has been rattling paper, we can even hear page-turning in documents, moving of coffee cups or any other object across the surface of the desk or table is broadcast very loudly into this room, to the point that it interrupts the speaker. And I would hate to terminate the conference call opportunity for other people because we can't continue in here.

But somebody or bodies, but I think it's a particular individual, talking, moving things, turning pages, shuffling paper is just very loudly broadcast in this room. And I would appeal to folks out there, if you can mute your phone, therefore your microphone won't pick it up, and just listen. And then turn it back on if you want to talk.

If you don't have that capability, just recognize that you really are interrupting things here by making noises there. And we appeal to you to please be careful and look to your conference call etiquette as much as possible, please.

Thank you.

MR. BETHGE: Good morning, I'm Carsten Bethge with WorldWater & Power Corporation. I'd like to thank you for the opportunity to ask these questions to Mr. Forsythe.

Two questions, actually. The first one is how much water do you lose in evaporation throughout your whole canal system?

MR. FORSYTHE: I'm not sure.

MR. BETHGE: Would you say 15 percent, 10 percent?

MR. FORSYTHE: That sounds pretty high, but --

MR. BETHGE: Yeah, it may be too high. Have you considered a fashion, this leads to my second question related to renewables and solar energy, have you considered maybe covering these canals with, for example, solar panels to provide some distributed generation as well as renewable energy to provide a twofold saving?

That energy could also be used to run pumps; that technology exists now to use solar to run pumps, which our company, by the way, has. Just wondering if you've given that some thought.

I know some district water management

utilities have been thinking about that.

MR. FORSYTHE: I guess my comment would be we're open to any energy alternatives. But the magnitude of our energy consumption is such that I'm not sure how many square feet of --

MR. BETHGE: Well, you have a lot of --

MR. FORSYTHE: -- solar it would take for a gigawatt, or --

MR. BETHGE: Well, you have what, 600, 700 miles of canals?

MR. FORSYTHE: Buried pipelines, canals approximately say 300 miles worth.

MR. BETHGE: Um-hum, that's a lot of area. Something to think about.

MR. FORSYTHE: Yeah, I guess cost is definitely an issue when you're looking at the amount of power consumption we have, that we would look for the most feasible opportunities for additional power supplies. But that's a good point.

MR. BETHGE: Thank you.

MR. TRASK: Any other questions? Thanks a lot, --

MR. FORSYTHE: No, there's one more.

MR. TRASK: Go ahead, please.

MR. ERICKSON: My name's Dave Erickson and I'm here representing the Climate Protection Campaign.

And I wondered to what extent you're incorporating metrics regarding greenhouse gas emissions due to your operations in your planning.

MR. FORSYTHE: As far as the State Water Project goes, most of our facilities are hydroelectric, so I don't believe we have any real greenhouse gases that get emitted. That's our primary source of power.

We do go out and buy some power in the open market, but we're dealing somewhat in a liquid market and not necessarily identifying where that source of power is.

MR. ERICKSON: But as far as your total energy use that you use from the grid, have you looked at metrics in terms of reducing or minimizing the greenhouse gas emissions due to that energy use?

MR. FORSYTHE: I'm not familiar with any metrics. As I said, most of the energy that we sell and we put into the marketplace is hydroelectric, so there is no greenhouse gases with that.

MR. ERICKSON: This is more on the consumption side.

MR. FORSYTHE: Yeah. Well, you know, we put a lot of power out. We buy a lot of power. So I guess we're probably the -- we are probably the single largest producer of renewable clean electricity in the state.

MR. ERICKSON: Yeah. Our experience has just been working with government operations to the extent they can improve energy efficiency and reduce the total amount of energy used. That benefits everybody.

MR. FORSYTHE: Yeah, and we try to -- our facilities are, you know, we are updating facilities as often as it is necessary to try to improve efficiencies. Our pumping plants are say approximately 90-some percent efficient. Our generating faculties are approximately 90 percent efficient. Much more efficient than virtually any other power process. We don't lose energy to heat, or very minimal energy to heat.

MR. ERICKSON: Thank you.

MR. FORSYTHE: Sure.

MR. TRASK: With that I'd like to move on to our next presentation which is by Dr. Lon

House. He's an Energy Advisor to the Association of California Water Agencies.

DR. HOUSE: Good morning. The purpose of this slide is what you already know, the precipitation in California occurs primarily in the northern part of the state, primarily in the Sierras. The use primarily in the southern part of the state.

The precipitation occurs almost exclusively in the summertime. And the use is year-round, or actually we use about 75 percent of our water in the summer months.

PRESIDING MEMBER GEESMAN: Let me ask you, Lon, what percentage of the water use is south of the Tehachapis?

DR. HOUSE: I don't know.

PRESIDING MEMBER GEESMAN: I grew up south of the Tehachapis and it wasn't until I moved to the Bay Area that the area north of the Tehachapis, but south of Sacramento, started being identified as part of southern California.

(Laughter.)

PRESIDING MEMBER GEESMAN: I always looked at it as northern California.

DR. HOUSE: And this figure is just a

followup to the previous presentations. There are a number of other conveyance facilities other than the State Project. There's the federal project and then there's a -- that's run by the Western Area Power Administration, and there's a number of them that are coming into the southern part of the state.

But the point of all this is if you look at where all of these things are converging, where are they converging? Los Angeles, right? There's just -- and it is -- the giant sucking sound that you hear is Los Angeles, or the southern part of the state using a lot of the water.

This is a summary of the water agency electricity requirements in California. And a couple of things I wanted to note on this graph. One is there is a constant demand for water, which is understandable, but for electricity we use about 1500 megawatts of capacity, peak capacity, virtually all year round. And that's understandable, as we become more and more urbanized there's the demand for water is continuous, not nearly as seasonal.

But you can see in this the seasonal aspect of it that has a lot to do with irrigation.

There is some seasonality to urban use, too.

But a couple of things I wanted to note on this. One is you'll note that the maximum demand that we have is about 3000 megawatts. But our onpeak demand is about 2500 megawatts. And that is because of the water agencies, and we're going to talk about this in a little bit, that are using their storage and are using various things.

The only reason I put this up here is because I think it's really interesting. And this is the peak day from last year. You notice that rebound that occurs at about 6:00, about 500 megawatts. That, over 400 megawatts of that rebound that occurs after 6:00 in the afternoon is water agencies. These are water agencies that have curtailed their demand and used their storage throughout the afternoon primarily in response to time-of-use rates. They're turning their pumps back on.

And this is a point that I make when I'm presenting this to the water agencies. If you want to see if you made an impact on California, just look at what happened at about 6:00 on September the 8th.

I'm going to talk about several of

these. You've already -- several other people have talked about them. Talked about conjunctive use, a little bit of desalinization, some climate change, and then some of the increased population.

What conjunctive use is, it's a term that is, I don't know if it's unique to the water agency, but within the water agency what it means is you're spreading water on the ground and you're letting it soak into the local aquifer. And then you're pumping it out when you need it. So basically what conjunctive use is groundwater recharge, or groundwater use.

This is just a -- this just shows you for Metropolitan, some of their conjunctive use, existing conjunctive use facilities.

And the next two slides are actually somewhat interesting. This is Metropolitan's above-ground storage for all the Metropolitan system. They have about a million acrefeet above ground. This is their conjunctive use storage. They've got about a million acrefeet below the ground.

So they've got as much water stored under the ground as you see in all these massive reservoirs. The difference is if it's stored above-ground, when you use it, you can generally produce electricity with it, because it's stored in a dam or a big reservoir.

If it's below ground, like all of these guys, you've got to pump to get it out of the ground. So one of the things that I noticed that we've talked about in this about is how much electricity is going to be used in the future.

One of the things I think would be very interesting, which I don't know the precise answer for, is to contact these various water agencies and look and find out what their connective load is for their pumps that are out in these fields. Because a lot of these pumps are -- we have seasonal conjunctive use, where we put it in the ground in the wintertime and pump it out in the summertime. We also have drought conjunctive use where we put it in the ground in wet years and we pump it out in dry years. And we've got hundreds of megawatts of pumps that have never been turned on in these facilities.

Here's just a summary of some of the new groundwater storage projects that MET is implementing right now. Now, this is a DWR graph, and these are conjunctive use sites that are being evaluated in northern California. And the concern is, when we talk about climate, is if the climate is shifting and we're getting out of the snow pack, and the storage that it provides, there has to be someplace to store that wintertime precipitation.

And so if you look at this graph, at this figure, there's a huge amount of area that is now being investigated for conjunctive use. Remember what happens is the water somehow gets to the land. It's either pumped to the land, or may get there by gravity. But getting it out of the ground requires electricity to pump it out of the ground.

And here's some additional -- and these are drought sites for southern California. And this is an interesting figure because what these 18 basins that are being looked at for conjunctive use storage in southern California are being evaluated for drought, which is we'll put it in in a wet year and we'll pump it out during a dry year.

So what will happen is you won't see most of this electricity until we hit a dry year. The other point that I wanted to make, as you look at this, this is about 21 million acrefeet. This is almost the amount of the total water use in California that they're looking at storing in the ground in wet years in southern California, and being able to use it during the dry years.

This is the last DWR update. We're all waiting expectantly for the new one. But the point I wanted to make with this one is that there is a difference -- is the bottomline, which is the shortage value. And on normal years we are still short of water.

What happens is -- about 1.6 million acrefeet. What happens is we have water in storage that we carry over from the wet years that allows us to get through a normal year. But if you look at a dry year, that 5 million acrefeet of water is a lot. And this was back in 1995, and I know that DWR, the new bulletin 160 will have new numbers. But that is a huge amount of water that's going to come from someplace.

If it is being replaced from conjunctive use fields, it is going to be pumped out of the ground and you're going to see a large increase in electrical demand.

I don't need to talk about this. You

know that there's about 20 new facilities that are being proposed in California. Total production that's being proposed, about 250 million gallons per day. And one of the things, the last time I was here I think Commissioner Geesman asked me about this issue about new water.

There isn't any new water in California. Hasn't been any new water in California in a long time. But at least it's been allocated since about the '50s. So we have the same amount of water, and we just reallocate it among the uses. We take it out of agriculture, we put it into urban.

And I assume someone is going to talk about some of the conservation programs. Conservation programs have been very successful in the southern part of the state. And basically they were able to double their population and use very little more water.

But, you don't make water. The only source of new water that's available essentially is water that's not fresh right now, that hasn't already been allocated. And that's seawater or brackish water. Or what we're seeing in a lot of areas is groundwater recharge using treated water.

But that has some issues that people don't particularly like.

The point of this, which was previously talked about by Matt, is that desalinization takes more energy than either the state or using Colorado River water, almost twice as much.

The drought impacts are really concerning the water industry. And it's funny, if you look up there right now, we're probably going to be okay this year because we got enough snow up there right now to -- we've got the equivalent of snow of the April snow survey, 100 percent of the April snow survey. Even if it doesn't snow anymore, we probably will make it through this winter, if it doesn't get warm in April like it did this last year.

But at our AQWA conference, I mean AQWA has a climate change working group that is very concerned about this. And the concern is that we do not have enough above-ground storage in the northern part of the state to store the precipitation if it comes as rain and not as snow. We're dependent upon the precipitation coming as snow. And basically melting throughout the summer. And the concern is if it comes as rain we can't capture it or store it to be able to use it in the -- throughout the rest of the year.

And one of the studies that was presented at the last AQWA conference is that the snow pack reduction in the Sierra can result in a loss of 2.6 to 4 million acrefeet of water storage. That water storage will have to be made up someplace else. Either through conjunctive use or some other way.

The drought in the southwest, if you looked at Lake Mead or Lake Powell, you can see what's happened there. They're getting a lot of this precipitation, too, this year. But I got a quote that I just had to laugh at, there was somebody in the southwest, a hydrologist that said no amount of precipitation, no amount of rain would end the drought in the southwest. And I thought that was just a funny quote, but, you know, from the point of what his point was they got five years of very severe drought back there. And it will take a deluge, Biblical type deluge, to refill things.

But the point of this is that California gets about 4.4 -- is entitled to about 4.4 million acrefeet of water out of the Colorado River. Now, the Colorado River, we talked about before, has been vastly over-allocated.

So the consequence of that is that you get some places where there's a significant amount of money, like Las Vegas, that gets, I think there's 300,000 acrefeet that they're allowed, and they're looking and they're saying we can't get any more water under our allocation out of the river, but we have to have more water to grow.

So what are they doing? And Matt talked about it. They have said, we will build or help build desalinization plants in California, and then provide fresh water for California, with the condition that California lets us use some of their allocation out of the Colorado River.

And this is a -- and I don't know how far it will go, but it's basically the only choice they've got. Is they don't have a lot of other water resources. And if they're going to grow they're going to have to get it from someplace else, and the Colorado River is over-allocated.

Okay, I just put this in here because this is kind of a -- it's got a lot of, you know, either very useful or worthless information in it. But the one thing that I actually found was kind of interesting about it is the column that says dry as a percent of average.

And what this is, is this is recorded dry river flows as a percent of average. And if you look on that, you'll get some of the rivers that we're using that are coming out of the Sierras, particularly those that are coming out of the granite facilities, the granite rocks, such as the South Fork of the Feather.

On a dry year they may get 10 percent of their annual flows. And so the point of the -- simply the point of this is that a drought can have a very dramatic impact upon not only our water supply, but also on our generation supply.

Okay. We are doing a lot of work on shifting our peak demands, the water agency peak demands. And basically we have three options. More effective use of storage, add more storage, or get customers to shift water.

Now, every water agency, I'm going to use every, every water agency has storage. Unless they're exclusively groundwater and maybe if they're ag. And that's because once water is treated it can never be exposed to the air again under the Clean Water Act. So they treat it in big facilities and then they store it someplace to meet the fluctuating demands throughout the day.

Now, the water systems in California were logically designed by water engineers, and sort of the mantra in the water industry is that a full tank is a happy tank. And so one of the things that you'll see, and I'll have an example in here of an analysis that we did that shows that goes in and demonstrates to the water agencies to be able to use their tanks, such as these tanks that they have for storage, for electrical impacts. And it can make a significant difference, okay.

And this is a study, AQWA has put together a technical assessment team that will go out and do analyses for water agencies on energy impacts and things like this. And this was a study that we did for Eldorado Irrigation District, and it's the Eldorado Hills subsystem, fresh water subsystem.

And basically this is what we said, this is what you guys should be able to do. A couple points I wanted to make here. One of the things is that this was two tanks, one was 5 million gallons and one was 3 million gallons.

And this is what we said, this is what we recommended the operating levels in the tanks. Basically what we did was we went in and we said, okay, you got these tanks; you run them up to about 38 feet. And then they had a set point of -- they would only drop it down to 28 feet before they started turning their pumps on. And we said, how about if you drop it down to 25 feet; just give us three more feet of freeboard in that tank.

And by doing that they were allowed to shift 2 megawatts out of the onpeak period. By simply saying you've got -- look at how much water you still have in storage. You can meet any contingency that you're looking at. Just give us some more room in the tank and let us drop it down.

And so what you've got here, and this is actually interesting. The top graph is the simulation. The bottom graph is what was actually recorded. And if you look at the bottom graph you'll notice that they're filling that tank up until about what, 2:00 in the afternoon, right?

So they're taking their tank, you look at that bottom graph, they're running that tank. And they're filling up in the morning; they use it in the morning; and they're pumping as fast as they can. And then when the demand starts dropping off they just simply fill up that tank again. And then what do they do? They go home, right, at the end of the day?

And this is another graph of saying, and this was using the Folsom raw water pumping, and it was exactly the same point, which is you guys already have the ability to do that. Give us some more space in the tank and shove it out of the onpeak period. This was an example. This example they were able to, out of 2.5 megawatts of demand, they're able to drop 2 megawatts off the peak period with no impact on water deliveries or safety of their system.

Okay, the last thing that we wanted to look at was a time-of-use water meter proposal. And actually this proposal is now in your lap, Energy Commission. Because we have a proposal that we submitted to the PIER program here, and basically what this says is that what we want to do is we would like funding for a demonstration project to put time-of-use water meters in on our water customers. Develop a time-of-use water tariff for our water customers, and then just like you see on the electricity side, monitor and see how much load, water load, which translates into electric load from the pumping from the water agency, is shifted by time-of-use water rates.

The water industry is sort of a mirror of the electric industry. We have basically generation, which is water; and we have customers, which are water users that are on standardized rates. There are no water meters, time-of-use water meters in existence that I'm aware of in the state, nor any time-of-use water rates in the state.

So we can use our existing storage more effectively; you can build more storage, which is very expensive. Or what the plan is here, is if we can get a demonstration that shows how much water we can shift by rate design, shift out of the onpeak, that will result in us having to supply less water and result in shifting our electricity demands out of the onpeak period.

And this is just an example. These are two water zones in, I think it's one of the southern California water agencies, and you'll see, there's typically a bimodal distribution of water deliveries. There's a morning and -- but, if you look at this you can say this is primarily urban. Whenever you see a graph that looks like this, that has water deliveries like this, you say this is primarily an urban, at least a water, an urban zone.

Because people get up in the morning and they do what - shower and turn on the dishwasher or cook breakfast, and then they leave. And then they often will come back in the -- or they'll turn their sprinklers or their irrigation or their water use in the afternoon.

So what you'll typically see, this is fairly typical, you'll see these two bumps. You'll see a morning ramping for water use, and then you'll see an afternoon. If we can get this zone on a time-of-use water rate, then we should be able to shift that afternoon water delivery peak out past 6:00 in the afternoon.

And that's the purpose of this proposal that we now have before the Commission.

Okay, water agencies, exclusive of those that are currently selling retail electricity, like Modesto and L.A. and those guys, we already have about 1500 megawatts of generation. And that slide on the rivers, I have one column there that shows you which water agency has how much generation.

We are designating essential services, and we have to have backup generation for all of our critical loads. So between a third and a half of all the backup generation in the state is owned by water agencies. The major pumping banks, water treatment plants, wastewater treatment plants.

Virtually all of the water treatment plants are suitable for biogas generation. Almost all the water treatment plants in the state produce methane. And there's a number of them, you can see, that have already gone into biogas generation, like Inland Empire. They've got, I think, 6 megawatts of microturbines they're firing off of their methane that's being produced off of their lagoon fields.

Virtually all water agencies have the potential for additional small hydro generation. This small hydro generation is absolutely benign. It's generally enclosed circuits. And as Matt was talking about, it's where they currently install pressure release valves.

One thing I wanted to add to this, too, is that solar is now becoming quite of an interest to the water agencies. And you notice in the last just month Semitropic, they're putting in megawatts of photovoltaics; Eldorado just approved a contract to put in megawatts of photovoltaics.

The point behind this is that one of the advantages of the water agencies is they have a lot of space. There's a lot of land. And if you look at these conjunctive use fields you got a lot of land out there that you don't want to put anything else on. They'd be perfect for installations of various technologies, like the solar technologies.

And so that's one of the things that you're seeing the largest developments in the state go in in water agencies.

PRESIDING MEMBER GEESMAN: Could you elaborate, why do you think that is? There's not a tax incentive or anything there for a water district.

DR. HOUSE: Well, I think that in both Semitropic and in Eldorado, I was, worked, advised them on that. They can get some of the incentives, the rebate incentives like you guys offer, and the Public Utilities Commission offers. But you're right, they don't get the investment tax credits.

But part of their charge, I guess, is they -- it's public relations. I mean they are very concerned about their -- because they're public institutions. And so one of the things that they do is the payback, even with the rebates, is fairly long on these projects. But in both instances, I think, they wanted to do this to sort of demonstrate the technology.

And they had -- well, let me just go into the Eldorado's. They've got a wastewater treatment plant, and they got all this land sitting around it, okay. And it's sort of just sitting there.

And so they said, well, we can generate electricity, but we can do something so this is a defined buffer between the outside and the water treatment plant that's been dedicated to doing something instead of just sitting there growing weeds.

And so I think it's a couple of things. They are interested in public relations; they are interested in the environment; and they're doing it as, I think, almost as a public service in many cases.

PRESIDING MEMBER GEESMAN: What kind of payback did those two projects see?

DR. HOUSE: They were looking at between nine and 12 years. Which is -- and the other thing, and that's actually a good point, that the water industry typically looks at very long paybacks. Like if you're putting in a $10 million storage tank, you're not going to pay that off in five years.

So you've got an institution that has a much longer, basically a much longer investment timeframe. Which is good for some of these projects. The question is the resiliency of the generation. And that's one of the things they're a bit concerned about.

PRESIDING MEMBER GEESMAN: Well, you know, a lot of talk in this town about a 3000 megawatt solar initiative with a lot of state incentive associated with it. These types of applications may offer a much more attractive payback opportunity than some of the residential applications that are focused upon so much in the media.

DR. HOUSE: Well, and then the other thing that I like about these is you're getting large chunks. And it takes a lot of houses to get 2 megawatts of solar. Where you've got one installation that's going in in Eldorado Hills that will give you several megawatts of solar at one spot.

PRESIDING MEMBER GEESMAN: Now the focus of the state program is supposed to be to increase volume so that manufactured costs can come down. That might be a pretty good fit, as well.

DR. HOUSE: Okay, in summary, the water agencies are the single largest end-use electricity user in California. We already shift about 500 megawatts out of the onpeak. We could shift at least another 500 megawatts easily by more efficient use of existing storage.

And I know that I, and a lot of the water industry, are really excited and really interested in this time-of-use water meter proposal which would allow us, if funded, would allow us to put in time-of-use water meters and time-of-use tariffs, and have the customer choose when they want to use water, which translates into the electricity we use.

We have probably 1000 megawatts of generation that we could put it in small hydro, biogas and with solar it could be however large you wanted it.

The drought significantly reduces hydro generation and increases pumping requirements. And in a prolonged drought you will see more and more pumping requirements coming out of these conjunctive use fields.

Climate change may significantly reduce the available water that we have for storage, but it has to be stored someplace. And it will be stored underground if we can't have facilities above the ground.

And so the point of this, there's a lot of opportunity and we're really excited about it. Because there's a lot of opportunity to, without much pain, shift at least the peak demands. But the concern, I think, for this Commission is, like I said, we're probably okay for this summer. But eventually we will hit a drought and we're going to start using those conjunctive use fields.

You add that with the desalinization facilities going in, and there's a significant amount of demand that California has not seen before that is going to be showing up sometime in the future.

Thank you.

PRESIDING MEMBER GEESMAN: Thanks, Lon. And, again, I can't thank you too much for the contribution that you've made, both today and in our earlier workshop last summer. I think that you and your clients at AQWA have served a real purpose in pushing us forward in this area. And I encourage you to keep pushing.

DR. HOUSE: Thank you.

MR. TRASK: Any questions or comments on Dr. House's presentation?

Okay, briefly we put out a revised agenda. We had a scheduling conflict that has been since resolved. So after this next presentation I think we're going to take a survey of the audience about what we want to do about lunch.

Okay. Yes, definitely, go ahead.

MR. RANDARAJAN: I am calling from WorldWater & Power Corporation. I'm right now in Pennington, New Jersey. I've really enjoyed all the presentations this morning, and it's coming through loud and clear, by the way. I hope I'm not one of the guys making noises. I tried to be as quiet as possible.

(Laughter.)

MR. RANDARAJAN: It's a very interesting topic, the whole thing, the water and energy relationship. I think all of you probably know of the Pacific Institute and NRDC report that recently came out about the water/energy nexus and quantifying various issues in California. It's an excellent report.

Our company, we have solar technology that makes it possible to allow large-scale water pumps directly off of solar. So I just want to mention that in addition to being able to save electricity and shift demand, which seems to be a big focus, during peak times, our technology provides the backup generation capability so that even in case of grid power loss we can directly run these very large-scale pumps directly off of solar. Which, you know, we're the only ones are able to do.

I happen to be intimately familiar with the Semitropic project. In fact, we spent a lot of time developing the project, but Shell Solar is actually eventually constructing the project.

When it comes to the water districts, because somebody raised the issue of no tax incentives available to the water district, one of the approaches that we've consistently taken, unfortunately we've not seen any takers yet, but one of the things that we're offering is third-party finance systems using solar. So that the third party, the investors, would extract the tax benefits, the depreciation benefits that solar projects get. And pass along those savings to the customer.

And in that process what we're able to do is to eliminate the whole issue of question of payback, because we're able to go to a water district and say we'll finance the project, we'll contract to provide energy services for you over a 20-year period, or whatever term that they are looking for, and offer them electricity at a discounted price and fix it for the next 20 years, so that they don't have the risk of price volatility as part of their program.

So we can give them savings from day one, so the whole issue of payback goes away. In fact, they're able to pay for these solar systems on a savings in their operating budgets without having to go for capital expenditures, new referendum and whatnot. And this kind of a third-party ownership also removes the burden of having to set up a separate depreciation account within the water district so that they are replenishing that depreciation account out of the capital -- you know, at the end of life cycle they have, need to buy another system.

So there's a lot of thinking that people like us are doing specifically, people like us meaning people in the solar business, doing a lot of thinking and doing work specifically related to the issue of water and energy.

I think you probably all know that an average home in Los Angeles consumes more energy that is embedded in the water it consumes compared to all the energy it consumes of water and air conditioning, I mean cooking, lighting and air conditioning and all of those kinds of stuff.

I believe the solar can play a major role.  I believe that there's plenty of real estate left in California to accommodate the land usage that somebody brought up at the table.  Not only that, it can be done locally in the distributed generation fashion that somebody mentioned, which means increased reliability and the backup power.

And one last comment that I want to make is I think Jim Tischer mentioned, diesel pumps in the Central Valley. The diesel pumps used for irrigation in the Central Valley are the largest contributor to particulate emission in the Central Valley. It's not the trucks and the cars and everything else; the diesel pumps are the single largest contributor to particulate emission.

There is solar technology available today that can displace all of those diesel pumps and improve the air quality. So this connection between energy, water and air quality, I mean it's undeniable in California. And there are technologies available now that can be utilized.

And we are actively exploring, trying to figure out if initiatives such as from those from (inaudible) and some of the initiatives from CEC can be combined to make a difference in this area.

I appreciate the opportunity to talk to you folks, and I'm really enjoying this presentation.

MR. TRASK: Thank you very much. Could you repeat your name and affiliation, please, for the court reporter.

MR. RANDARAJAN: Yes, my first name is

And, that's A-n-a-n-d; and my last name is Randarajan; it's R-a-n-d-a-r-a-j-a-n. I'm the Executive Vice President at WorldWater & Power Corporation.

MR. TRASK: Very good. I'd also encourage you to submit us some written comments. That's an interesting area.

MR. RANDARAJAN: We're planning to do that.

MR. TRASK: Very good. We're running a little behind, so unless there's any pressing questions right now I would like to move on to our next presentation, which is by Dr. Bob Wilkinson. He's with the University of California at Santa Barbara, and also with the Pacific Institute.

DR. WILKINSON: Thanks, Matt. Actually, let me correct on the agenda. Gary Wolff, my collaborator on the particular project we're going to talk about today, is with Pacific Institute. And I'm with the University of California.

Let's see, in the two and a half hours that I have allocated before lunch let me see how fast I can rip through this. I have a number of slides. Let me just make a couple of opening comments, though.

I'm really pleased to have the opportunity to contribute to this 2005 Integrated Energy Policy Report process. I think the five questions that you have posed are very good ones. I'm going to propose at the end a couple more that might tag onto those. But I think you really framed the question correctly.

And I, too, in my comments am going to advocate that we consider some of the air quality and other implications of potential benefits of the work that the Commission is doing and DWR, as well.

I'd like to applaud this interagency effort. And I say this quite sincerely. I've had the opportunity to serve on the Bulletin 160 California State Water Plan Update Advisory Committee. I've worked with the Commission on the PIER program with some advising on your climate research. I served on the desalination task force. And it's my sense that all too often agencies are not cooperating enough. And I know it's not that easy to do. So, I applaud your efforts to make that happen. Maybe perhaps even build a slightly bigger tent with some of these other players in other parts of the state.

When I started working on this in the 1980s, this link between energy and water I was asked to submit some testimony to your Commission. I think you were both involved in processes that related to this time.

And I just wanted to share this insight. I was asked to submit testimony, and then I was held by the hand by one of the CEC Staffers who said, this is what is important for you to say. Indeed, the staff knew exactly what they needed to do, the Commission knew what they needed to do, and the DWR Staff was very well aware of what was needed. But there was a need for some kind of outside validation for what made sense.

So in that spirit let me assert that in my experience staff already knows a great deal about what needs to be done; you do, too. And so to the extent those of us from academia and outside organizations can come in and perhaps validate some of the work that's already going on, and then hopefully answer some of the questions about some of the unknowns that could be answered. That's a nice role to have.

So, this is Gary Wolff; he is the principal economist and engineer with Pacific

Institute. And I run a water policy program at the graduate school, the Bren School, at the University of California at Santa Barbara.

I'm going to try to quickly run through four points: an overview of this water/energy nexus; and then you're going to hear after lunch the energy/water nexus, I think, so we've got a nice tagteam going here with Lawrence Livermore. Talk a little bit about the notion of energy intensity, what that means; energy inputs to the California water system, I'm going to have a little bit of repeat from what's already gone before, so I'll try to skip through that. And then talk a little bit about some research questions and where we'll be proceeding, Pacific Institute and University of California on one study, funded by your PIER program, looking at energy inputs into California's water system.

So we get energy from water and we use energy to supply, treat and use that water. So it's going both directions. In fact, it gets interesting, we use energy to pump water, for example, in the system, so you've been hearing about the state system. Then it takes water consumptively to produce some of the energy that it takes to then keep pumping that water. So we've got some interesting iterations back and forth that we need to understand, perhaps, a little bit better.

The guesstimate is around 7 or 8 percent of the state's overall usage. We hope to get a cleaner number on that. I don't know the current thinking, but that's probably in the noise. Terry Tamminen cited a 40 percent number that somebody gave him; that was a surprise to me. I think it's probably closer to the 7 or 8 percent.

Key concerns for both water and energy; reliability of supply is a concern; cost for both supply and the quality that's needed. The quality for various uses, and this has to do both with power, but in particular, I think, with water. And concerns with environmental impacts.

Other similar issues. We've got an historic supply-side orientation to providing both water and energy. Infrastructure is important to all these systems. We have huge end-use efficiency opportunities in both. We're still recognizing that rather than having exhausted a lot of those opportunities, find new ones.

New technologies are changing our notion of optimal scale. This gets into the DG issue and some of that. There are issues with both water and the energy system, along those lines. Market distortions and market impacts in these systems play a role.

You mentioned, Commissioner Geesman, the difference between peak power and what's really translated through the rate structure and the signals that people get, there are similar issues in both.

And then disconnection between pricing and cost, which is perhaps another part of the same thing.

This so-called new management strategy, integrated management, water, wastewater, stormwater energy, it's new and it's old. In the energy world we've been talking about this for decades. It's being applied in various arenas. Part of that gets then to multiple benefits. With a given investment in a policy or a program, we often focus on the particular costs associated with whatever the measure is. Increasing a wastewater treatment plant, for example, or increasing conveyance systems for water supply.

But we often fail to look at the whole

system and then look at all of the benefits that would accrue from certain investments, compared to others.

And that ties, then, into portfolio strategies, really understanding supply management risk and cost, not just as a diversity of supply, but a real ranking and understanding of the relative value in certainty, quality, et cetera, of different supply options.

I think you all know this, but the common unit we're using in water these days is this arcane notion of an acrefoot, which is an acre covered with a foot, and there's the translation factors for those that don't live in this water world of acrefeet.

Energy intensity is an important idea that we're exploring further now. Some work that I did, funded by the Commission, through the California Institute for Energy Efficiency then, now Energy and the Environment, is the embodied energy, is the total amount of energy calculated on a whole system basis required for the use of a given amount of water in a specific location. Because it matters where we get the water and where we end up using it. And all of the energy inputs to the whole stream.

Here are the four key areas of energy input into water systems. The primary water extraction, wherever we get it, pumping out of the ground, taking it from some surface system. Conveying it someplace. Storage in some cases, particularly if we have offstream storage like San Luis. Or groundwater, as was mentioned in the previous presentation.

So then we take it, put it someplace. It takes some energy to get it there and then get it back out, although there is energy recovery in some of those systems, as well.

Treatment and distribution within a service area. So, say once it gets to Metropolitan in southern California, they have further treatment and distribution energy.

Onsite water pumping, treatment and thermal inputs, water heating, moving it through buildings, additional treatment and so forth.

And then finally, wastewater collection and the surprising amount of wastewater that's actually pumped around. It doesn't all flow by gravity. And treatment. And then that cycle over again.

(inaudible) is one of the big factors throughout all of these systems, not the only. And I should mention pumping air in wastewater treatment is the lion's share of the energy going into wastewater treatment. So it's pumping, but it's not pumping the water. It's pumping the air for aeration in addition to water pumps in those facilities.

On the end-use side we've got onsite treatment, we've got water softening, additional filtration and so forth within buildings. We pressurize it in buildings like this, recirculate it through the buildings. We have thermal requirements to heat or cool it. And then, again, we've got the wastewater pumping and facilities.

Some of the questions that we need to look at. When is water used, on a diurnal pattern, a daily pattern, and seasonally. And Lon just touched on some of this with time-of-use are some interesting questions there, understanding when we use water, where we use it, and where the energy connects to that system.

Water used in southern California has an energy demand and it starts with the banks pumping plant, for example, or the state system runs down that whole stream of pumps, and then into southern California. So the energy may be needed somewhere else, from some other provider, in order to get water for use in another part of the state. So we need to understand that, I think, better.

How much water is used, and what are the sources of that water. I'm going to talk a little bit about a couple of different options of sources that are being used with some energy numbers attached to begin to fill out this picture.

So, some of the research questions we're looking at, where and when will water systems use more energy. If it's a desal plant in southern California, it has a different characteristic than if it's imported water supply from northern California or groundwater or reclaimed water within, say, the southern California basin.

Where and when will water systems use less energy. That would have to do potentially with efficiency improvements, re-use, shift and supply options and so forth. I'll give some examples.

And what information and data do we need to support good policy. I think, if I understand this process correctly, there are research questions but they're not for their own sake because that's interesting and those of us in academia like to do that sort of thing, but how can this better inform policy to get good cost effective investments for California.

California's water systems are uniquely energy intensive. I've looked at systems throughout the country. I'm now working some in Canada on this. And we've got some of the most energy intensive water anywhere. And that's partly because we've created plumbing systems that takes water and moves it over mountain ranges, so whether it's the Colorado system coming in or the state system.

Of course, some of the earlier systems, L.A., San Francisco are net energy generators. They started higher up, plumbed down, and so they captured both. So we've got both systems.

Here's the same picture before the conveyance systems. I'll skip on through that.

The Oroville Dam that you saw. The conveyance system, this is the State Water Project going down, that's I-5 along the side. This question of evaporation and, as we pump water from the beginning at Banks, and what actually ends up at the other end of the system, and what is the loss is an interesting question.

I have a graduate student working on that and I think the numbers are non-trivial. We don't know precisely what they are. They might be somewhere in the range of 4 or 5 percent, maybe more. It's hot, dry and windy down the backside of the mountains behind Los Angeles, so there's a pretty high evaporation rate in that area. And even in the Central Valley at times.

The Colorado River system, of course, generates energy. But then uses a significant amount of energy for the Colorado River Aqueduct to bring that water over. Some of the same issues.

Here's a quick sketch of all the pumping plants from the Department of Water Resources, focusing now just on the state system, so you can see where those exist. I'm going to move quickly now so there's no quiz.

Taking all those pumping plants, putting them into an Excel spreadsheet, this is based on Department of Water Resources' same schematic, but doing it in a way where you can change these numbers and they click. You can see down to the east branch terminus we're at about 3200 kilowatt hours per acrefoot. That's a lot of energy per acrefoot. That accounts for all the energy recovery coming down the backside. It's up around 4444 up at Pear Blossom.

Now, you may be aware there's a lot of development up in this area, so there are ideas of a lot more water demand starting to occur on the Tejon Ranch and some of the other areas up high. That has an energy implication for California. If we're using it here, it matters versus using it in other parts of the system. That's very energy intensive. This is still very significant.

The west branch, it's a little over 2500 kilowatt hours per acrefoot. That's to get raw state water to southern California. From there Met takes it. They do more energy recovery in some cases, apply more energy in other cases, do treatment and distribution.

If you average all this out, and you take the import from the state project as the marginal most energy-intensive water, and you add in everything except end uses within buildings, did not calculate that number, it works out to about 3500 kilowatt hours per acrefoot on the margin.

That means if you change toilets or change systems that require less water, you're saving about 3500 kilowatt hours per acrefoot. For Art Rosenfeld I translated that down to 0.01 kilowatt hours per gallon, because Art likes a metric. And so that's the metric for Art.

But that gives one a sense of how to calculate out the energy benefits fairly readily, at least in terms of electricity, of water efficiency improvements. This is basically Met's service area, so it's a very large area, and this is averaged out. Okay, it's going to be higher --

PRESIDING MEMBER GEESMAN: (inaudible) characterizing southern California south of the Tehachapis?

DR. WILKINSON: That's correct, within Met's service area. Now, it goes up and down. There are places it's more than this, if they're concentrated on east branch water or up high. And some places a little less. This would be an average value. It's non-trivial.

There's the systems, again. I'm going to skip on through.

Here's sample water energy usage with

water based on a report done for you back in 1992. And you can see if you look at water pumping, this is for a sample city, water pumping, wastewater, you're looking at more than half the energy. So we're talking very significant part of the energy use for water.

Here again is one of the slides on agricultural use. This is from a good study that Charles Burt did; again for the Energy Commission. And we cite each other's work back and forth, so I'll just throw up one slide on this. But this is interesting to look at, agriculture and where we have the most energy intensive water for agricultural production. That doesn't mean we don't have ag in those places, but it tends to be a higher value ag where the water's more energy intensive.

Here's the total water withdrawals in 1990 from the USGS. Here's the new one that just came out for 2000. You can see this remarkable spike in our part of the world.

This is important because we actually now are in a situation where every major water supply system in California is over-allocated. Think about the Colorado River, we're on the 4.4

diet plan, helpfully enforced by our friends at the federal government.

Think about the Central Valley systems; we're cutting back on the Trinity River diversions that are diverted from the coast in; we have issues in the north end of the state with fish and the rivers there. We're taking less from the Mono and Owens system coming down the backside of the Sierra. We have millions of acrefeet of groundwater overdraft in California.

So everyone of these major systems is over-allocated, and we're having to learn, institutionally, and as users, how to work within limits of these systems, and indeed, use a bit less and get more value out of that water use. So that's from Shasta at the top of the state all the way down to the Colorado River in the bottom of California.

Here's our sophisticated policy process.

(Laughter.)

DR. WILKINSON: And you asked us not to talk about that in this arena because DWR's handling it. But I thought it was only fair maybe you share some of the burden here to enjoy the fight.

Bennett Raley, who's the outgoing top water guy for the Department of the Interior made this quote this last year. I think it's apt. He says the new paradigm of the century is water supply issues will no longer be driven by droughts. We will have conflict in normal years. And that conflict will affect economies of national importance. Demands for water in many basins in the west will exceed the available supply even in normal years.

We support for two reasons. Of course, droughts count, but we're now into a policy arena where we need to deal with this all the time, not just in dry years. So your long-term planning, integrated planning, I think, is particularly important because of that.

That led me to -- reminded me of a little cartoon I've got. The caption there says: Sir, the following paradigm shifts occurred while you were out." Indeed, this is moving rapidly.

(Laughter.)

DR. WILKINSON: Now, here's another one that's a little bit counterintuitive. A couple of slides on water use and population curves from the USGS report that's just out. Every five years they do a very good study on water use in the U.S. It's the most comprehensive study we've got to work with.

You see the population line continuing on up fairly stead, but you see this leveling off on per capita withdrawals of water. One way or another we're getting more efficient. If you look at that in a crummy, kind of fuzzy slide, but in a lot more detail, you're looking at public supply here, you're looking at irrigation leveling off. This is about 1980. And so you're looking at trends broken out by the different use areas that shows something rather interesting for the last decade or so, which is a drop and a leveling.

There are a lot of dimensions to this, why this is occurring, pricing, technology and so forth. That's important for us to think about, though. We made some mistakes in the energy arena decades past of putting rulers on graph paper and making assumptions. I think we need to be much more careful about understanding what the implications are for both energy and water of changes in population, but also technology and uses.

I should say the Pacific Institute has

done some very interesting work, Gary and his colleagues, applying this to California. And they've got some more detailed information on California, and we could submit that, as well.

Now, I want to take you back to 1990, and so this is talking about the 1980s, during the last decade. This is Metropolitan Water District. The arena of long-term water resources planning has been broadened to include conservation as a promising management alternative. Water supplies are currently undergoing the same change which took place in the energy industry during the 1970s.

Earlier recognition and quite a bit of sophistication on the part of the water community in learning from some of the experiences, the successes as well as the mistakes, from the energy sector and building in new planning approaches. This is kind of the old system. This is one of the water -- I think this is one of Met's slides -- on how we tended to use water in the past.

The trouble with following the herd is stepping in what it leaves behind, though. And that system was leading the problems. So we're shifting into all kinds of things from more efficient appliances, cutting once-through cooling systems for x-ray machines and saving 90 percent, and on and on. A lot of the work that Mary Ann Dickinson is doing with the California Urban Water Conservation Council and others. So we've really shifted.

Now, a lot of this came about because of the Energy Act in 1992. That's what's regulating toilets. A little bit of a disconnect for some until you think about this embodied energy, the energy intensity in the system. So the Energy Act established these various plumbing fixture codes and so forth at the federal level. California had already gone through this at the state level, as you know, so here's some of the standards for toilets, showerheads, faucets and so forth.

What's important about this, as with energy and the Bill Keese speech, if I may, that these policies really do matter. That over time this has made a big difference for California's economy by using resources a lot more efficiently, saving a lot of money, strengthening California's business community and all the rest.

Here's quickly the uses in a house. I'm going to skip on beyond this. Maybe Mary Ann can talk about some of that.

So, if you look through -- this is another quote now from Met, in less than a decade, by 1998, have gone much further since then, Met and its member agencies had already replaced a million water-wasting toilets; they've done ultra low flow, in place of those, distributed three million low-flow showerheads. And they've saving huge amounts of water. And bear in mind the marginal water would be some of this most energy-intensive water. And they've gone a lot further now with landscape programs and other things. So have their other member agencies.

So I'm going to characterize or challenge this way, that if we step back and get a little perspective on the situation there's a lot more opportunities for California, and they're not just water and just energy, in fact just air, but these multiple benefit opportunities that actually could be quite exciting.

This is the historic system, these interbasin transfer systems. They are important to our system. We do need to maintain and use them. But take a look at performance on those systems; this is again from Metropolitan Water

District from their urban water management plan. Local supplies are, guess what, almost half of the total water supplied to Metropolitan's service area, and steadily growing.

Here's the L.A. Aqueduct; that's squeezed down some. Colorado, as you know, we're having to ratchet back a bit. And the State Water Project, which is very important, but highly variable through time.

So, 46 percent of the water used in Met's service area, the entire area from Ventura to Mexico, is local supplies. If you go to something like the Santa Ana River watershed, Orange County and on up through the Chino Basin, you're looking at anywhere from half to 70, 80, 90 percent local water in southern California. So the myth that everything comes in from the outside isn't quite there. There's a lot of good work already going on with those agencies in southern California.

Let me just quickly talk about one example. This is the Inland Empire, part of that watershed, the Santa Ana watershed in the southern California basin. And here are the water supply options for that area with a couple of additional for comparative purposes. I don't know if you can read this slide.

Recycling water is down about 400 kilowatt hours per acrefoot. The metric here is kilowatt hours per acrefoot. That's because if you have to treat water for legal discharge requirements anywhere, taking that marginal amount so that it can be reused, is actually quite an energy bargain.

Groundwater pumping in that area is around 950. It varies, of course, on depth in different areas. Water treatment using ion exchange is around 1000. Desal using RO systems, reverse osmosis, desal of the groundwater is running at about 1700 kilowatt hours per acrefoot. And, indeed, they're using that biogas that was just described, running it through turbines, using it in the RO system to desal water, and that is the municipal water supply of Chino Hills. Very high quality water.

Guess what? That's less than raw water from the Colorado River Aqueduct. And the product water here is actually lower salts than the Colorado River. There's a bargain. So if we can do more of that we've got an energy bargain and a local supply option for southern California. Also more of a drought-proof solution.

Here's the west branch. They don't take west branch, show water at that location, but I put it in for comparison.

Here's the State Water Project. So now we're looking at some of these local groundwater options being half or less of imported water through the state system. My guesstimate on desal, and we don't have good enough numbers yet for desal at scale in California, my guess is somewhere around 4400 kilowatt hours per acrefoot. And I would assert that's a rather squishy number, so it could be up or down.

The interesting thing is we're starting to get pretty close to desal, which is why some of the folks here have argued, I think appropriately, that we need to at least look at the desal implications for energy systems. Because folks really are looking at moving ahead with desal, including for reliability reasons, that may be a little more energy intensive, but they can turn it on anytime they wanted.

Here's what those systems look like. Of course, membranes, and the energy goes into developing high pressure with electric motors running pumps to push it through the membranes to get the salt out of it.

Here's that watershed. Here's the permeability in that watershed. And I throw this out because one of the most energy efficient and cheapest sources of water in that area is to simply get more water in a storm event, like we just had in the last two weeks, to drop into those water sheds, into those groundwater sources so that it can be used in those systems. And it's a very significant amount of water. We're talking millions of acrefeet potential.

So as it stacks up against these other systems, there's something huge there. When you look at the land use pattern, that red is the paved areas. You've got a lot of runoff now. Creates a lot of problems, that's what it looks like when it rains down there. Trying to develop systems to get that water in the ground actually has a very strong energy and water supply benefit. It also has a very strong air quality benefit.

This is some of the traditional systems. This is nothing new. They've been doing a lot of this in that area. This is somewhat new, trying to go a decentralized recharge systems. So various incentives and approaches to help people do more of this actually has some very significant energy benefits for California.

Here's the Inland Empire Utility Agency's new platinum headquarters building in the Chino Basin. And I put this up not only because it's of interest to the energy folks here, and I'd really encourage you to go visit their facility; it's quite impressive. It came in at mid-cost of tilt-up concrete building, which is about as cheap as you can build. So you can build a platinum building for quite a bargain.

But this is the interesting thing. Light surface for heat island effect. Fully permeable parking lot using concrete; they poured it about eight inches. And the water drops right through it. So you get the permeability, you get the energy benefits. Again, I kind of think perhaps we could develop incentives for co-benefits on these sort of things. Lots of groundwater storage.

This is the official position of the Inland Empire Water Utilities Agency. Here's business-as-usual, if you will, using imported water and the demand. I won't go through all the significant numbers behind this, but here's imported with their urban water management plan. This is the relevant one. Come a drought, they're able to drop off of the state system and take the pressure off to allow other users for that water and issues in the Delta and rely on the groundwater storage.

So they've now, I think it's rather a bold move, gone public and said, by doing this groundwater recharge and so forth, we can cycle off the system, take the pressure off others and not import during those crisis times.

If more agencies that can do this were doing that, that would have a significant impact on the energy as well as water.

Another quick example, and this is looking at four sources for central and west basin. This is the same slide that Matt put up. This is based on work I did for those utilities this last year. Looking at their imported deliveries, and that's with that west branch energy involved, natural recharge is actually very low energy intensity.

If you import water and then recharge

it, of course it goes up a little bit, you've got it. Recycled recharge is a real bargain. And that carries on down a couple of their systems.

The important thing here is that recycling water in that area is a tremendous energy benefit. So the more of it we do, the better. And, of course, a lot of that is going to oil refinery operations, industrial uses in southern California. So we've got an important benefit there.

Similar case with west basin. The two utilities are co-managed, and they have similar interests. And they're going to a very serious look at desal as part of their portfolio option, along with the reclaimed and the groundwater.

Climate change. We know these changes could be quite disruptive for California. Just put up one slide, and some of you have heard my rap on the whole climate change situation. This is from the official U.S. assessment of the impacts of climate change for the United States, and I did the California component of that.

The Canadian model is showing up to 100 percent increase in precip in the whole region, clearly it's out of scale, missing the origraphic effect. All the rest, the Hadley model showing a lot more in the south. This may be quite wrong, so I'll quickly say this is just a model run. There are more recent model runs showing just the reverse, a drier future. I throw it up only to say that if this is anything like a scenario for the future, or if we have oscillations between this and drier futures, that water management may take a new dimension in California in terms of centralized, decentralized technology we apply, all the rest. And so we need to take that into consideration.

Here's quickly the potential impacts of climate change on our water system, and I'm going to skip by that, other than to say we've got potential for problems all the way around. Increased evaporation, increased transpiration, increased frequency of both droughts and floods. So we have some interesting difficult policy challenges in planning for both water and power.

So, my stirring conclusions. With the focus on multiple benefits, we target goals to be achieved through well-designed investments and policy strategies. And I think that's part of what we need to work toward in this integrated plan.

Integrated water management strategies and improved end-use efficiency can provide significant multiple benefits including energy savings, improved environmental quality and increased water supply reliability.

I think there is a role for policy. We may need to light a fire under some folks, but I think everyone in this room gets it. We need to look at what are the energy implications of different water strategies and water implications of different energy strategies.

So, from the renewable energy portfolio that you're dealing with, Commissioner, to the transmission issues and where we're going to need energy when, and what does that mean for transmission, we really need to look at those connections.

We also need to look at these multiple benefits of integrated water energy plus policy strategies and what values should be placed on those.

We need to define boundaries of what is being integrated as inclusively as possible. For example, energy water, wastewater, air and other impacts. And I think this is quite possible. And I think that Alan Lloyd and company at now California EPA, but the whole air quality side of this, a lot to offer. So I'd urge that we see what we can do to increase participation from that set of folks, as well.

We need to develop broad consensus that we have the right parts in the right order of this picture and this pattern to develop a shared understanding, really, of this whole water/energy nexus. I think once we do that we can really understand where we have holes in the data and information on where we need to do some more work.

The CEC's PIER program is, I think, immensely valuable as a means to facilitate critically needed policy-relevant research. The focus on important unknowns that will inform robust and cost-effective integrated policy strategies is an important part of what your PIER program is already doing.

So, thank you. Let me, if I may, ask Gary to say just a couple of words on behalf of the Pacific Institute. We're going to be collaborating on this analysis of the energy inputs into California's water system over the next couple of years.

MR. WOLFF: I apologize for dragging you into the lunch hour, but this will take just about five minutes.

I wanted to briefly tell you about the two reports that have already been mentioned this morning, where you can get ahold of them, and just a few words about what's in them.

Both of these analyses were done under my direction at the Pacific Institute. Both of them have input and advice from Bob and built on some earlier methodological work he did.

The first one was done in substantial collaboration with the Natural Resources Defense Council. And it's called energy down the drain. It includes case studies, as well as general discussion, about the energy in water management linkages in California. There's a case study of San Diego County Water Authority; and it's the urban case study. There's a case study of the Westlands Water District, that's the agricultural case study.

And this report can be obtained in full on our website www.pacinst.org.

There are a lot of interesting things

that came out of the case studies, but the one that probably is the highest level and all I have time for today is to point out that in the urban sector the energy use on the customer side of the water meter, that is the energy that's co-used with the water is at least as large as the energy that it takes to deliver the water to the customer and to take it away and treat it as wastewater.

So some of the numbers you've been seeing, for example, the 7 to 8 percent electricity number that Bob had, or the 3500 kilowatt hours per acrefoot of energy number that Bob put up, those are only half of the energy use in the urban sector. It's twice as big probably, based on one case study. So that's something we really need to get our hands around.

I also need to point out that saving water probably saves energy in the urban sector. There seems to be a complimentarity to the two because of this relationship with customer use, the water energy being co-used. That's not necessarily true in the agricultural sector.

So in agriculture saving water may require more energy use or less energy use, we don't really know yet. And that's something we also need to understand better.

The case studies there were done in a methodologically consistent way, and built on the methodology that Bob had started, but extended it. So you can do things like add up the energy that's used in transporting water to a user and the energy that's used in wastewater treatment, and add them up in a consistent way, accounting for water losses. Add energy in all the steps in a way that it accounts for losses.

If you just added the energy together and divide it by the number of acrefoot delivered you'd get funny numbers. I mean you lose almost half your water in residential sector that's consumptively used. So the energy per acrefoot of water that's treated, wastewater that's treated is a very different thing than the energy per acrefoot of water that's delivered.

So we did some things methodologically in the case studies that are talked about in the first report.

We then realized that we needed to extend that methodology even further and add an air quality layer onto it, and make that available to people to run their own case studies.

So that led to this report, which is the user manual for the Pacific Institute water-to-air models. The manual and both models are available again for free on our website. And the models allow you to do your own case study, to look at your own energy use for any two scenarios of water use. So you build the scenarios and you can get an output that tells you, here's how energy uses differ between them, and here's where energy uses differ between them. Is it in customer use of water, was it in wastewater, was it in supply, et cetera.

It also allows you to do things that other speakers today brought up. For example, you can't specify in both scenarios the exact same water from the exact same sources, but different types of energy used. So you can compare electric grid power versus photovoltaic power and see what difference that makes for the seven criteria air pollutant emissions and carbon dioxide.

You can also do things like look at direct diesel pumping of water in the agricultural setting versus pumping with an electric motor powered off the grid, or powered by hydro or powered by some other source.

So the model's very open and flexible in general, and you can use it as you like. And I hope you will use it and send us information about what you're finding.

So, with that, I'll turn this back over to Bob and/or Matt for lunch.

MR. TRASK: Any questions for Bob or Gary?

PRESIDING MEMBER GEESMAN: Thank you, both; both for the work that you've done in the past and hopefully for your ongoing contribution to this effort going forward.

I'd ask both of you if you're aware of any research that's been done or information that's available that would provide a demographic overlay so that we could assess likely demographically induced trends in California in the future.

I mean it would strike me that with population growth projected to add another 50 percent to our current 36 million, within 20 or 25 years, and increased urbanization, that you're going to see more water moving from agricultural implications to urban use. There must be some energy implications to that.

DR. WILKINSON: That's a very good point. First, let me suggest that Paul probably has some very good information because the DWR folks have been looking very carefully at this. And the implications if a lot of the growth is occurring in Palm Desert and so forth, you've got some implications for both energy, air conditioning and water use in those climate regions.

So they've looked at demographics and population. Nobody's got a crystal ball, but I know they've looked very hard at this, so maybe there's some good sharing there. And the Department of Finance has got a lot of the data, but there's still a lot of debates about that.

I think it's very important, and I think that might lend itself to some scenario exercises. What if DOF stuff is roughly right, what's that going to mean for us. What if we redirected some of the growth in different areas. What is scenario A or B plays out, what does that mean for California's energy.

But I think that could have some big implications for transmission and generation and water use and all the rest.

MR. WOLFF: Let me speak briefly to that, as well. The model is sort of a first step toward getting at that answer. The model operates at the scale of the water district, or of the water system, the State Water Project could be input as a single unit to the model.

But what we don't know is we don't know -- we don't have total statewide numbers that are credible yet. We need to use this model in a series of places and then scale up to the state level.

Once we've done that, and that's what the spaghetti chart project is that we're just beginning, once we've done that then you can take the total credible statewide numbers and start to do scenario analysis on them. What if we grow in this way or that way, in this region or that region, and get to exactly the question you want.

PRESIDING MEMBER GEESMAN: Thanks very much.

COMMISSIONER BOYD: That's kind of the macro scale, probably -- I was thinking Commissioner Geesman's question went in the direction of my thinking, as well. I was, as you were speaking about your latest model development, I suddenly started thinking of our own PLACES model, and how they might interface in some way to just increase the decisionmaking. It's probably a little more micro scale, but it, you know, just downsizes the issue to the folks, the local decisionmakers, the local land use planners who have ultimately major ramifications on how we develop.

MR. WOLFF: That's a good point, and I would have to look at how this might be able to interface with that. This does work at the scale, as I said, of the water districts. So even without knowing statewide numbers you could project, you know, two different scenarios for the future in a service area and then interface with this other model, at least in concept.

DR. WILKINSON: One other interesting question, as I looked at the Inland Empire area, which is, as you know, one of the fastest growing areas in California, if one were to shift more to groundwater, more to reclaimed water, because of the energy intensity of those options relative to the existing supplies, you actually could see population growth and energy and water use decrease by a shift in strategies.

So that's the kind of scenario we need to play out, too. Just even with existing population, what are the choices of technology and strategies that we could employ. And then through policy, incentivize, encourage, and so forth, that we could get better results through time.

MR. MASSERA: This is Paul Massera, DWR. I kind of alluded to it earlier, how the water plan addresses what you had just asked, and that is we do break down our water use, our future water use estimates into those key drivers like population and distribution of the population. Probably not to the geographical level that you were referring to, however.

We do break it down -- at least we plan to break it down into 30-some-odd planning areas throughout the state. But that would be our approach, break it down to those key factors.

PRESIDING MEMBER GEESMAN: Well, you know, I think it would be productive then to get our electricity demand forecasting people together with your staff and determine what type of scenario we could realistically put together for this particular report cycle in some geographic subset or some planning area that might provide some valuable illustration of this issue.

MR. MASSERA: Certainly.

MR. TRASK: Commissioners, as staff we have been looking at these issues, or places people are involved at this study, so we are looking at opportunities to develop that.

PRESIDING MEMBER GEESMAN: Yeah, and I think to the extent that any of them are listening at their desks in the building, I think the electricity demand unit needs to think through what they can contribute to this effort in this report cycle.

MR. TRASK: Any more questions or comments? Okay.

Our original agenda had us already at lunch. We had a revised agenda because of a scheduling conflict that has since been resolved, so we have the option now to go to another presentation or to go to lunch. So perhaps we can get some feedback?

PRESIDING MEMBER GEESMAN: There's no option.

(Laughter.)

PRESIDING MEMBER GEESMAN: Why don't we come back at 1:30.

MR. TRASK: Very good, see you then. Thank you very much.

(Whereupon, at 12:32 p.m., the workshop was adjourned, to reconvene at 1:30 p.m., this same day.)

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AFTERNOON SESSION

1:38 p.m.

MR. TRASK: Welcome back. I did have one little housekeeping thing. We do have a sign-in sheet outside, and I'd appreciate it if people would sign in there. What's important about that is if you check the email box to get notices, I will place you on both the IEPR mailing list and on a special mailing list just for this study so that you can get notices of future workshops and so forth that we'll be holding.

Okay, this afternoon we'd like to get going with a presentation by Robin Newmark who is with the Lawrence Livermore National Laboratory.

MS. NEWMARK: Well, thank you for the opportunity to speak. This will be a slightly different talk, partly designed to keep you from going to sleep after lunch, and partly to introduce you to some work that's going on at my national lab. But more importantly, to alert you to an interesting opportunity that has just appeared. And I've just come literally from D.C.; I've been there the last few days working on some of the details of it.

And some of our earlier presentations

today have been very eloquent at stating the case for the energy/water nexus, itself, and so I'm going to kind of gloss over some of the scene-setting context comments, try to get to some of the more, the different comments here.

I think we're all aware that energy and water are very closely interlinked. In order to sustain population and economic growth we both consume energy and water. Energy production requires a great deal of water. Water conveyance, storage and treatment, as well described this morning, uses a great deal of electricity.

It's more like 4 or 5 percent nationwide, and in California obviously it's approaching 10 percent.

From a national laboratory perspective one might ask why would we be interested in this. Well, certainly energy is part of our mandate. And so we looked locally at Livermore at what were the national and regional issues facing us with respect to energy and water and where we had unique capabilities that could make a strong contribution.

And we focused in fairly rapidly on three areas. I'm just going to highlight some of the things we're doing in these three areas.

One is the input factor. The climate impacts on our water availability and water supply. The second is once the water gets to us, how do we manage it. And there's a series of projects on groundwater management. I'll just highlight some of the things we're doing there, because, of course, that has energy implications as well.

And the third is the development of a new generation of energy efficient selective separation and treatment technologies. Again, the idea is to increase the new water supplies by diminishing the economic disincentives for treatment.

As most of you know, water management planning in California and much of the U.S. depends on the past to predict the future. We used about 80 years of historical hydrologic data through a series of water simulations models to compare and contrast our understanding of future water deliveries and future demands.

And in a surplus year the water managers can make decisions based on that experience. For example, store water in dry years, and in a deficit year there are other decisions to be made. And all this factors into such financial incentives like capital improvement programs, investments in areas for infrastructure.

However, we know that we are already experiencing hydrologic change that might indicate that using the historical record may no longer be valid. And the big question is how are we able to provide water managers and the energy managers who are helping support this infrastructure incorporate our understanding of these changes and give them some understanding of what's going to happen in the future, which many people call climate change.

Now the added impact, which again we already talked about this morning, is the fact that the State Water Project is the largest single user of electricity in California. And anything having to do with the water infrastructure, management, treatment, delivery system requires a great deal of energy.

So what we're doing is simulating California's climate and hydrology at very high spatial resolution which allows us to look at individual watershed impacts and estimate the uncertainties.

As Bob Wilkinson showed earlier today, there are many global climate models, regional climate models and predictions that indicate various amounts of dire to modest impacts. The big question is how well do we know that.

So the difference between the individual approaches and our approach is by using literally the world's most powerful computers is we're using multiple models and trying to get at the error bars with which we understand any of these implications.

We take global climate models run at actually unprecedented resolution and use those to drive the regional climate models. What you see is a grid size of 10 kilometers. Right now that's running on the second most powerful computer in the world. And it is providing the kind of information such as what is the actual Sierra snow pack implications, because we're able to incorporate the actual typographic information that many of the low resolution models are not able to address.

We then use those to drive surface hydrology models to look at things like individual, unimpaired stream flows for input to water infrastructure models. Other information we get are soil moisture, evaporative demand, difference based on different crops or different vegetation. The kind of things we look at extremely detailed regional climate implications at a watershed scale to provide that information to water and other agencies.

And, for example, part of this work is supporting work for the California Energy Commission in their efforts to understand regional climate change on energy demand.

Now nationally we rely heavily on surface water, and we return more fresh water than we consume. And I don't expect you to read everything on the spaghetti chart, just look at the thickness of the bars on the right side and left side.

The left side says we use two and a half times more surface water than we use groundwater. Something like that, maybe four times. And we use it in various different ways. And then we dispose of it, we return it in different ways.

We return about two and a half times as much as we consume nationally. This is based on the 1995 U.S. Geological Survey report. You saw data from the 2000 report earlier. This data actually is the last benchmark that showed the actual uses and consumption versus disposition data.

Now, California's trends are a little bit different. California represents 10 percent of the volume of the previous chart. We use almost as much groundwater as surface water. And we consume or evaporate much more than we return. And I would like to argue that this is more indicative of future trends, both in our area and actually globally.

Now, once that water comes to us, that which is not surface water, we're finding -- and even surface water, we're finding is increasingly hampered because of contamination. And there's a wide selection here. Some of our more popular contaminants, nitrate, arsenic, perchlorate and increasing introduction of pathogens, viruses, bacteria in recycled water. These create management issues and they also indicate opportunities for selective treatment rather than full treatment of impaired water sources.

So with respect to this, as we get into

the groundwater, we're looking at developing tools that allow us to manage those resources more accurately and, for example, help water agencies decide how to do their buildout of additional groundwater wells.

For example, the depth to which you drill a well will be directly proportionate to the amount of energy you use to pump that water once you get it into production. We're working with a series of agencies, local and federal agencies, water agencies in a multifacet project where we're looking at developed microbial tools to -- and probes to look at the actual level of denitrification occurring in any one particular site; benchmarking in a field-scale field site in cooperation with the dairy industry in the Central Valley. And incorporating those results into reactive transport models that agencies such as the Santa Clara Valley Water District can use in their decisions on buildout for groundwater resources.

Treatment is a big issue. As you know, the last significant federal investment in treatment technologies was in the '70s. And that is basically the technology upon which most of our treatment is based now.

We're going back and looking at the 30 or 40 years worth of understanding of ion transport in water and in fields to develop new selective separation techniques that can be used in existing systems like RO systems, electrodialysis systems, but changing out the membranes so you can pluck out those constituents that you don't -- that are undesirable, such as perchlorate, arsenic, various endocrine disruptors like the tomoxifin. This would be a great energy reduction, because now you're not removing absolutely every ion load in any particular volume of water.

Another project we're looking at, improving the economics of renewable power. In this situation you've got a geothermal plant that would like to use the local geothermal water for cooling. Unfortunately it has a fairly high load of ingredients that are detrimental to the cooling system.

The alternative, of course, is to import expensive water from somewhere else. So, instead, if you're able to treat the local water for power plant cooling that would be very nice. Except, it's quite expensive.

So what we're doing is looking at the ingredients that are added, the geothermal constituents that we want to remove and look at their economic value. It turns out that at the Mammoth field, the gross annual value in millions of dollars is shown in the lower portion of this chart. The silica alone is worth $8.6 million a year.

One of our projects is, for example, removing geothermal silica from the waters so the water can be used for cooling. But then that becomes a revenue-producing stream. It does not offset the total cost of treatment, but it certainly makes a big difference.

If you notice things like cesium, $100 million; lubidium, $90 million. If you look at the kind of geothermal fluids in southern California they have a different suite of co-contaminants that actually can become a revenue-producing stream.

So those are the kinds of things that we've been doing. But what's really exciting to me, in addition, is the policy perspective. The national laboratories, and you see here 11 different national laboratories' logos, all independently came to the decision that energy and water are going to be the big issues for the 21st century.

We started working together about a year and half, almost two years ago, along with EPRI, to develop support for a national energy water security program. And it's called the energy/water nexus team. It's a working team.

And I think we can kind of gloss over some of this, but obviously the competition for water limiting energy is not just a California issue; these are headlines from newspapers all across the United States, Georgia, Idaho, North Carolina, New Mexico, Pennsylvania where power is now being limited by the availability of sufficient water of sufficient quality.

As we all know, fresh water is used for producing electricity has now hit the even parity mark. About 40 percent of our fresh water withdrawals in the 2000 list were used for thermal electric cooling, which is equal to about, you know, the same amount in irrigation.

Now, of course, some of this water is returned, but it also has some impair issues, because, of course, their thermal effects, et cetera, with irrigation is actually consumed. So they're not exactly the same statistic.

Energy is used for wastewater treatment in our world, and this sector is significant; it's equal to many of the other significant industrial sectors of the U.S. economy. Pulp and paper, chemical petroleum refinery, all have had a great deal of effort looked at their efficiencies. The water and wastewater treatment industry is only now really focusing on the efficiencies, both in respect to energy and with respect to water use.

Now from the federal perspective there are a number of agencies that address water. And you're looking at 17 different logos. And all of them, this is sort of the primary responsibility for water in the federal system. However, no agency has the programmatic responsibility for water-related impacts on energy policy, water used by energy production and energy used by water systems. And this is the nexus that we call the water for energy/energy for water system.

Now, this slide was really developed for DOE. We were trying to explain that this is a DOE issue. Two of the four main strategic goals are at risk, and energy strategic goal and the science strategic goal. And the fact is that DOE has significant capability that could be used to address, and are already being used in a very uncoordinated fashion, to address portions of the energy/water nexus.

The DOE labs have had a great deal of activity along those lines. I don't expect you to read all the list of meetings, but the first one was this comment about regional workshops, which were conducted in various states. And, in fact, a couple of years ago we were talking with the California Energy Commission to conduct a similar one in this area. And I think this study that you're undertaking with DWR is a tremendously important factor in the new opportunity that's come along.

Critical outcomes of a program at the federal level would include a number of things that are already being looked at or are underway locally here in California. Quantification, prediction, new science and technology, the science bases for energy/water policy decisions, and the development of information decision tools. These are all sort of the technology side of the policy questions that we're discussing today.

Now on the federal level in the last year there's been a growing awareness and a lot of activity. In the Energy Policy Act of 2003, which, as you know, did not pass, there was a section called the water and energy sustainability program. It began to look at the federal need to assess and develop a program plan to address future water resources needed for energy and energy needed for water purification.

Shortly thereafter -- well, along the same time, two companion bills were submitted in July to create an energy/water technology program in the Department of Energy. One was sponsored by Senator Domenici and introduced by Domenici with a number of cosponsors; and the other was the companion bill introduced in the House by Representative Pombo.

Now, these bills did not get authorized during the last Congress, but there's a process underway right now to introduce revised legislation. At the same time, however, they were able to create an appropriation to begin the roadmapping associated with the development of such a program.

In the original bills Livermore was named the national laboratory lead for Pacific Regional Center. What I didn't go into the detail was that this program would involve regional centers, each focused on a suite of themes or technology themes. Each would be led by a national laboratory and a university or university partnership; and there would be a fairly significant grants program to which other organizations and institutions or even individuals could apply.

There's also a policy institute and a tech transfer function, because the program is really directed at the development and the implementation of new technology. Obviously there are policy issues involved in the acceptance and implementation of any new technology.

So Livermore was named as one of the leads for one of the regional centers. And it's interesting to see that the themes that were placed in that center are very complementary to the issues we're hearing about today; and are addressed in the questions for this study.

Point-of-use technology, water treatment and conveyance, energy reduction, co-located energy production, water treatment where desalination would be included in that, and water reuse for agriculture. These are really themes that California has a vested interest in.

So in terms of what has happened, this is sort of the history of what's happened with respect to the legislation. The important thing is that the implementation plan for this program is being developed now and there's a roadmapping exercise that will begin in the next few months.

This roadmapping exercise requires the participation by industry, associations, regulatory and state institutions. And I really welcome interest by some of the people or the organizations represented today. Obviously the activities of the CEC effort now are very complementary and would be a tremendous contribution to this effort.

So, finally, from the national lab perspective, the requirements require a number of things, assessment; technology development; tech transfer, which involves policy aspects; and of course, basic science driving it.

The Energy Policy Act kind of lived in the assessment and basic science world, and it did not pass. The water technology R&D program was developed to address technology development, tech transfer functions. And that is still moving along. And I firmly believe something's going to happen on the federal level in the next year or so.

My contention is that the energy/water relationship whitepaper, which is underway here, will identify some of the key issues for California and be an incredibly important contribution to the national discussion, as well.

And with that I'll stop and answer any questions that may come.

PRESIDING MEMBER GEESMAN: I want to thank you for your presentation, and offer our cooperation with the Lab and the national effort going forward.

I do want to follow up on one thing that you touched on very briefly in one of your slides. You said that you thought that California's pattern of consumption and evaporation was increasingly likely to represent a precedent followed nationally and globally, as well. And I wonder if you'd elaborate on what you meant by that.

MS. NEWMARK: I think that the most important aspect is the increased reliance on groundwater supplies. I think that in our world unless we want to make a strong commitment for surface storage, which does not seem to be the political or social will right now, we are tapping groundwater at an unprecedented level, and we're looking at how to manage that in banking and conjunctive use scenarios. I think we're really leading the effort for the nation from that perspective.

If you look at another region, the northern midwest, Illinois, around Lake Michigan, these are areas that are actually quite water stressed because they're beginning to tap and draw down their groundwater resources. It's hard to believe because you're sitting right next to one of the largest fresh water bodies in the planet.

However, if you look at their use scenario, it's beginning to mimic much more the use of our Central Valley and urban conflict. And I would forecast, if you look at the growth predictions for those areas, they're going to look a lot more like California. Maybe not on a full state level, but certainly in those regions that are already beginning to get stressed.

I'm not sure that would be the same thing as in Florida and Georgia, which are also quite stressed. But, again, you're seeing more reliance on groundwater and a change in the use pattern and the distribution of the runoff.

PRESIDING MEMBER GEESMAN: And are there similar drivers in each region pushing us in that direction?

MS. NEWMARK: I don't know who said this, and I'd love to have the quote, which is that water is a global and a national issue, but it's experienced regionally and locally.

I think that the same issues are present almost everywhere, but the form which they take, and the way that they are experienced and the thought behind a solutions base will vary.

For example, there's an arsenic problem in the southwest. There's a tremendous arsenic problem in the northeast, except it's different. Because there it is mobilization of arsenic due to acid rain. It's not primary sedimentary origin arsenic.

The ultimate issue is they've got arsenic in the water and they've got to get it out. So the technology solution in that case might be the same, but the way the regulatory context is set, the way that societal acceptance is set will be different. But it's the exact same technical problem.

So this issue of tapping groundwater may be driven by slightly different things. There are agriculture/urban growth issues. But I think they're experienced and will be solved from the regulatory and acceptance perspective slightly differently.

And that's why we've been looking at a national program that has strong regional input, because again, we'll have these same things cropping up, but the priorities and the solution space for implementation might be quite different.

PRESIDING MEMBER GEESMAN: You also alluded to global parallels in terms of California's consumption and evaporation. What are your thoughts on that?

MS. NEWMARK: I think the best example of the dropping of the groundwater basin is what's happening in the Beijing area in China where they're experiencing over ten foot a year drop in their groundwater basin. And they're initiating tremendous controls on water use because of it.

I read a statistic which I couldn't believe, but basically this was from a World Bank fellow saying that there were 30,000 wells being drilled every year just to replace wells that had gone out. Now, this is a huge basin, but it gives you the scale. And this is an area where you have rapid population growth. And the agricultural issues look quite differently. You don't have huge farms in that area, but almost every home has a small garden plot. So the ag/urban conflict exists there, but it looks totally different in terms of how you would address it. The technical solutions may be identical.

So that's an egregious example, but there are others globally.

PRESIDING MEMBER GEESMAN: Thank you very much.

COMMISSIONER BOYD: You mentioned, and this may not be a question that you can or want to answer, I'm not sure it's even a question, more of an observation, but you mentioned the societal, et cetera, conflict with regard to building reservoirs. And thus, the need to look in other directions, particularly at groundwater.

And I've just been wondering if, concurrent with all the discussions we have on energy/water and water in general, the discussions that are taking place with regard to climate change, and the perhaps changing patterns of precipitation in California, whose water system, I'll simplistically say, to me the largest reservoir we depend on now is the Sierra snowpack.

And if that diminishes, and a lot of the reservoirs that do exist that are so environmentally controversial, are built to capture that snow melt in the admittedly beautiful or pristine areas in the mountains and what-have-you.

If we end up with the same amount of precipitation or even more, but it's more rain and less snow, I'm wondering if different kinds of reservoirs, and I believe the Sites Reservoir was referenced, but more valley-floor reservoirs, or reservoirs that might be more acceptable if we quit growing houses too quick, to the general populace might become acceptable to the society. And maybe help stem a total run on the groundwater, or else help the groundwater recharge or et cetera, et cetera.

Have you ever heard any discussions of that?

MS. NEWMARK: Yes. I have to thank you for raising that. The comment that I made was really reflective of the U.S. Bureau of Rec's water 2020 kickoff, where Bennett Raley, who was quoted earlier today, spoke for the Department of the Interior, behind the intent of water 2020 which was to say that there is no longer a federal sugar daddy. We will not be building large significant western storage. That was the statement.

Therefore, water 2020 was initiated to bring everyone to the table and say we really need to learn to work together. That was sort of the context. And I'd prefer to leave that quote to him rather than to say, you know, stick a match in the kerosene for that.

However, there are a lot of other alternatives. Deep storage conjunctive use, surface storage in other configurations than it had previously been considered because the use and purpose and duration of function have changed or will continue to change. Those are very important to address.

One of the early, or what I would call transitional aspects about climate change impacts on our existing infrastructure and the earlier snow melt of the Sierra snow pack, the seasonal shift in precipitation events to begin with is the fact that the Corps of Engineers, who has responsibility for flood control, and whose regulations most reservoirs are managed under, is very aware of the potential for rethinking the whole issue of how you manage flood risk.

They have not been mandated to address this specifically, but this is certainly something they're thinking about. Certainly those water agencies who manage reservoirs, we have a representative from one of them right here, East Bay Municipal Utility District, and there are many others, they are very aware of what I would call transitional or short-term operational changes that they could consider to address it.

But, yeah, there's a systemic issue, particularly in California where our whole infrastructure is based on an assumption that may be moving.

MR. TRASK: Very good. Our next presentation is by Mary Ann Dickinson with the

California Urban Water Conservation Council, and she'll be talking about the current state of conservation as soon as I can get it up here.

MS. DICKINSON: Hello, Commissioners Boyd and Geesman, and thank you very much for inviting me to come and testify. This has been a fascinating hearing with a lot of great expert testimony. I've learned a lot here today, and want to thank the audience, too, for hanging in and coming back after lunch.

I've been asked to come and talk to you about conservation and how a role of water conservation actively implemented in California can help to reduce energy usage. And it's an issue we've been taking a look at at the Council for a little bit of time, particularly since the 2001 energy crisis.

But I wanted to set the stage first by talking about just water efficiency in general and how it's evolved in the State of California.

Traditionally, water efficiency and water conservation programs were invoked by many water agencies as a drought response. You know, they wouldn't bother doing conservation programs unless there was some supply shortage or other crisis condition of supply that meant that they had to temporarily reduce customer demand. Usually they did it through media programs or public information programs. But they never really thought of it, in the '80s anyway, as a long-term water supply measure. It was something that provided short-term relief, short-term demand reduction. And that's how many programs started in the '80s.

I've been in water conservation since 1986, and for the most part we were considered, you know, environmental programs. We were not considered engineering operational programs. We were all located in public affairs.

That perception has changed. Many conservation programs in the early '90s, particularly in California, as well as in other parts of the country, were moved into the planning departments of these water agencies, because the utilities began to realize that conservation could actually yield a measurable amount of supply that could be used in their planning projections for how they were going to meet demand in the future.

So, as integrated resources planning became a preferred planning option for many water agencies in California, they began including in their supply mix water conservation savings, or conversely, representing it as a demand reduction. They could do it either way, count it as supply or count it as a demand reduction. But, in any event, it was lessening that growing gap between available supply and growing demand.

But then as we started to empiricize this field and do some real economic evaluation of those savings of conservation we increasingly began to consider conservation an economic tool. Conservation defers needed infrastructure into the future. That has a present value that can be expressed in economic terms, as an economic benefit to the water utility infrastructure.

And so by deferring capital facilities for not just drinking water, but especially for wastewater, which often costs twice as much as a drinking water infrastructure treatment plant or whatever to build, the deferral of those facilities into the future has enormous implications for the economy of the nation, as a whole.

The City of New York installed 1.5 million toilets purely to avoid building a secondary wastewater treatment plant because they had run out of capacity. And they completely eliminated or deferred into the far future the need for building that facility.

It's estimated that the United States, as a whole, will spend about a quarter trillion dollars by the year 2020, and the energy standards that are embedded in the Energy Policy Act for water are a tremendous savings and an infrastructural deferral.

We did a study at the Council, which is available on our website, where we analyzed the national plumbing standards and what value they served in terms of that infrastructure deferral. It's roughly between a 5 and 8 percent demand reduction which then can translate out into infrastructure benefits, which is worth millions to the nation, as a whole.

But now we're also in the CalFed process, in the bulleting 160 process, where we're all very active. Water conservation is also an environmental tool. It's a way to leave water in stressed watershed estuary conditions. It's a way to provide additional environmental flows that are critical at certain times of the year, particularly in the dry months. Water that can be stored because of the conservation program during the wet time can then be applied during more dry periods and provide extra flows in some of these stressed water aquatic systems.

So, we've evolved in our perception of what water conservation delivers. Now, of course, we're beginning to look at this water/energy connection, and how water conservation can then have energy benefits.

Bob showed you the Energy Policy Act chart, which I'm going to flip up, as well. I'm only going to show you this because that was really the start of the policy recognition on the part of the federal government in particular, that, gosh, there's a connection between water and energy.

And at the time that we were lobbying nationally for this I was at the time on the east coast in a state just like California that had adopted its own plumbing code. There were 13 such states around the country.

And the energy, DOE was basically saying, you know, we don't want to get into the water business. We're not water people. And to a large extent they carried that point of view for a very long time. I think it's changed now.

But that extraordinary nexus between water and energy was not very conveniently perceived in the early '90s.

But these, as Bob mentioned earlier today, these standards made a huge impact because it began to tie in the issue of water and energy together in a very important piece of federal legislation.

California, what did it do following that? Well, we have always had, since 1983, an Urban Water Management Planning Act, which is part of the water code; requires water agencies serving more than 3000 acrefeet or more than 3000 connections to file every five years a water plan showing how they're going to meet their demand needs with their supplies, in whatever configuration, for the next 20-year period. And that plan requires consideration of water conservation measures, which I will get into in a minute.

We also, about the same time as the passage of the Energy Policy Act on the federal level, we signed locally here in California a memorandum of agreement with water agencies and environmental groups in 1991, the end of 1991, that basically committed all of those parties, water agencies and environmental groups, to pursuing good faith efforts to implement conservation programs that are cost effective.

And the marriage of the environmental and water supply community was very key, because basically what the environmental community was saying, we're in this with you. If you do these conservation programs we see no reason to litigate on the issue of sufficient amount of conservation savings.

And to date we have not had any litigation on the issue of adequate efficiency on the part of the water agency community. If they're involved in the memorandum of understanding, it's a tacit understanding by the environmental community that these are important benefits.

The Council that I work for is the governing body and overseer of these demand management programs. And so the memorandum of understanding, which is available on our website, and I'll finish this presentation with the URL, sets up best management practices that every water agency should be conducting.

And the original negotiation came up with 16 of these in the various sectors, residential, commercial, industrial, large landscape, and we're now -- we've revised them. We've revised them on a regular basis, and now we have 14. The revision process is very current. We want to make sure that those measures stay in pace with technological developments. These measures are referenced in the water code. They're required in your water management plans to be examined. An agency has to actually demonstrate why it isn't cost effective to do these programs.

And how they implement these programs and the extent to which they implement them are reported in an online database that the Council maintains. And I'll show pictures of that in a minute.

Just want to quickly whip through what the 14 measures are. We'll eventually have 16, but we'll go through that in a minute.

Residential water surveys are the first one. Residential plumbing retrofits, where you go and actually change out the plumbing, rather than just retrofit with a temporary device. System water audits, leak detection and repair on the part of the water utility system.

Universal metering with commodity rates. You know, pricing that reflects the quantity of water that's used, and is priced accordingly. Large landscape conservation. The sixth one is high-efficiency washing machine rebates, which we have newly revised based on the standards adopted by CEC.

Public information. School education. Commercial, industrial and institutional conservation. Wholesale agency assistance. They're required to give retailers not only financial, but technical incentives. Conservation pricing is one of our BNPs. Conservation coordinator, that's actually a best management practice because it was deemed important to have one person to whom the public and the elected officials could go to when they had questions.

Water waste prohibition refers to local ordinances that are passed to prohibit water wastage in the community. And then finally, ultra low-flow toilet replacement.

We also have best management practices that are in the potential stage, and they're being considered for addition. One that we're considering adding is BNP 15, is an outdoor landscape residential landscape best management practice.

We're also considering what we're calling sort of performance track, one-basket approach where we'll give a water agency a target of what all of those 14 measures say, and then they can choose to meet that target any way they wish. That's also under consideration.

So, are these measures affordable? Well, conservation programs typically cost between $56 and $750 per acrefoot of saved water. So depending upon the cost of -- the avoided cost of water to the water agency, that can be very very cost effective water.

But the memorandum specifies that only those conservation programs where the actual avoided cost is higher, those are the programs you'd need to do. if you've only got $200 an acrefoot cost for your water, you wouldn't be expected to do a $750 conservation program, because obviously that wouldn't be very cost effective.

So, that's the basic benchmark. It's scaled to the avoided cost on the part of the water utility. And by contrast, most water supply development projects cost much more than $150 an acrefoot. I'm a resident in the Lake Arrowhead Community Services District. Our current avoided cost of water is $2300 an acrefoot. So they're doing conservation in nearly every residence because it's a huge avoided cost that they have to meet.

So, what's our progress to date? We spend close to $100 million annually statewide. We've retrofitted, just to give you a simple benchmark, over two million of these high efficiency toilets. We're now talking about super high efficiency toilets. So we're carrying it further.

We expect in the most conservative study that's been done to date, the estimate is 770,000 acrefeet annually of savings by 2010. We're going to be doing a separate analysis of what we think the savings are. And I'll show you pictures of that in a minute.

And to quote a statistic that I think

was mentioned earlier that's always bandied about, southern California has the same consumption as they had in 1984, but they have three million more people.

So, what is the Council and why are we here and what can we do? We provide a lot of -- technical assistance to the water agencies that are doing conservation programs. We help them analyze what those programs cost and what they save, which is how we can come up with the benchmarks of cost per acrefoot. And we keep that data very current. We're in the process of revising our most recent research effort on this. It's something we pay close attention to.

And this document that we publish on the costs and savings is actually read not only around the country, but we sell copies in other countries as well.

Bob Wilkinson and I co-wrote a paper and it was presented in Jordan. And the paper we wrote was on the water/energy connection. And I was amazed to see how many people were in the room just for that paper because this is an issue that transcends every country, especially where countries are arid and transport water, as we do here, there's a lot of cross-over information.

So, the kind of research we do we are very careful to keep it current. We publish guidelines for how you do the cost effectiveness analysis. And we do lots of customer surveys and analyses of plumbing code issues. And we're currently conducting an analysis of what the environmental benefits are of conserved water. And that's a study that we're doing with Lawrence Berkeley Labs.

We also help our members calculate how to meet their actual requirements under the memorandum of understanding. We do a lot of training workshops. We train their staff people, as well as give them specific skills.

And we spend a lot of effort on our website. We have special information pages on each of the BNPs on how they can run their programs. We have lots of research studies that are posted from all over the country. And we lend out some of these studies, which are quite expensive to our member agencies.

Here's what our website looks like. The URL for it is cuwcc.org. And I encourage you to visit it. We have a lot of information that we try to make available for free.

We're also, as the CEC well knows, we're doing a program with the California Public Utilities Commission. We're not just helping water agencies do programs, we are actually doing programs.

This is a program where the Council, itself, is installing pre-rinse spray valves in restaurants. Each one of these devices saves 200 gallons of hot water per day. We've installed over 18,000 to date in this program statewide. We've gotten a second phase of funding from CPUC to keep going and add another 20,000. Benefit cost ratio of 4.9. It's an extraordinarily cost effective program at $56 an acrefoot. It set a new benchmark for how low we can go in terms of our cost of acrefoot.

And I think you'll remember that we came and testified in support of the pre-rinse spray valve standard, because even though we're going to be replacing a lot of these statewide, these valves only have a life of five years. So, these savings are short term unless they're replaced with the same efficient standard fixture. So you've adopted a standard at the same standard as what we're installing.

What else do we do? Well, we gather data on what those conservation programs actually are in the field. And this is what I think can perhaps be useful to you in your research efforts. We maintain a database-backed website for BNP reporting. Water agencies log into or website; they report online what they've done. And then it aggregates up into statewide statistics.

We have converted those statistics into a savings model where we roughly can approximate what those savings are for each of these program activities. We're testing that model now. It's in a beta testing phase. Some of the results in aggregate form are already posted on our website.

But as we continue to fine tune it over the next year I think we can use this as a way to continually measure on an ongoing basis what these programs are saving.

And we believe that the verification of what the data as entered, and it's a self-reporting system, after all, but the verification of that data will actually improve if the CalFed recommendation for certifying water agencies is passed by the Legislature. This would require that every water supplier be certified that they're doing these best management practices, and that they receive an official certification from the state board. Once that program is put in place, then the savings numbers will have an automatic verification process.

Here's what it looks like on the website. And I put up one best management practice form. And they just go online and they fill in the boxes. We've tried to make it very standardized so that we don't have, you know, fuzzy inputs that can't be matched.

The system is interactive. If they don't complete it, the system actually shows them in red, you forgot this box, or this value isn't an appropriate value for that particular field, and gives them an actual feedback.

And then once it's ready to be filed there's a little button that says submit as final when you're at 100 percent. And then you submit the form, and then it automatically rolls into the statewide roll of numbers.

And so here's an example of the statewide roll of numbers. We have to report to the state board every year on the activities of the conservation community. And every two years that report includes a summary of these roll of numbers.

Here, during this two-year reporting period, 2001-2002, these were the numbers for the various different activities. Residential surveys, there were 201,000, et cetera, et cetera.

Now, you look at these numbers and you think, well, that's not really very high for a statewide program. And while that's a very valid observation, I need to caveat this by saying not everybody reports as they should because it's not required. And secondly, not every water agency is a member of the Council. So these are just those agencies that have signed the memorandum of understanding.

We will have the reporting numbers for 2003 and 2004 within the next four months. And I'd be happy to share those with you. And we will also have those numbers tied to the savings projections so we can then, at that point, give you a roll up of what has been saved in California as of 2004.

I think you saw this particular pie chart before in one of the other presentations, and I put it up here, Bob, I think, gave me a little segue to say I should talk a little more about it.

Urban water use in California is between 55, 60 percent of residential. And of that residential about half of it is irrigation. So although we've spent a lot of time in the indoor parts of the house, because it's been simple and fast to do those plumbing fixtures and appliances, we're now needing to go into the outdoor component because that's really where a lot of California's water is going, and therefore, energy. So we need to pay attention to how we're dealing with landscape.

We haven't really done a lot of that in the past 15 years. We're just starting to come up with those programs now. And the reason we're doing this is for the same peaking reason that Lon House was mentioning in his comments this morning. For conservation programs it's typically a seasonal peak. It's a peak in June and July where water systems have to be built to meet that seasonal peak. And so to the extent that you can bring it down with irrigation efficiency programs, you're bringing down that peak.

I would love to see a peaking chart for daily time of day. Until we have time-of-day metering we're not going to be able to really measure where our water use is going during the day. But that's, I think, the direction we're needing to go to, particularly as we consider the water/energy issues.

In landscape we're starting to think as creatively as we can. And in California we have a weather information system called CIMIS, California Irrigation Management Information System, where they have a series of weather stations all over the state.

And now we're introducing and testing in a number of areas -- East Bay MUD's here, they're doing a program -- with taking these irrigation controllers that will read a satellite signal from these weather stations and automatically adjust the controller. And take away the role of the homeowner in when the irrigation system goes on and off. So the homeowner would no longer have to program that controller; the homeowner just let's it happen through the satellite signal. We're beginning to think about these new technological areas as a way to deal with landscaping.

We're also trying to recognize that landscape water efficiency, which will help bring down that peak, is really a function of people. It's people management; it's the homeowner, and it's whoever takes care of the homeowner or the commercial owner's property.

And in that respect the landscape contractors are a key part of the solution. Here's a program that was piloted by the Municipal Water District of Orange County where they actually have a website. Landscape contractors have all of their meters for their landscape. They're dedicated irrigation meters, on the website with a budget.

And this website, when they click onto that meter, will give them a budget; it will give them the usage statistics for that meter; give them what the budget should have been based on the climatic and ambient weather conditions during that period of time. Give them a water budget in hundred cubic feet; give them a cost. And then if they meet the budget, this is what their savings would be over what they experienced before. And then if they don't meet the budget, this is what the cost is, the added cost of the water.

And this has become an extraordinary management tool for reducing irrigated water. And the study that was done to evaluate this, they found that at the end of the study period they had about 1500 active meters that were as part of this study.

The water savings were pretty extraordinary. The beginning part of the program, as people were getting used to it, they had 393 meters, and the contractors were just starting a program. They got about 365 gallons per day. But the later participants, as they got into the swing of the program, were saving almost twice that, 765 gallons per day. But the peak season savings were 1300 gallons per day, which is probably the most important input, because it's clear that landscape conservation can help reduce that peak.

Annual savings for just 1500 meters was almost 1000 acrefeet. That's pretty extraordinary. The lifetime savings --

PRESIDING MEMBER GEESMAN: Where was this program?

MS. DICKINSON: I'm sorry?

PRESIDING MEMBER GEESMAN: Where was this program conducted?

MS. DICKINSON: In the Municipal Water District of Orange County.

PRESIDING MEMBER GEESMAN: Okay.

MS. DICKINSON: Southern California. So the lifetime savings of this program, if you have it over a five-year period, is about 4800 acrefeet.

This chart shows the seasonality of savings issue. It actually shows that peak reduction in demand during that July period.

So, landscape is something we're starting to look at as a way now to bring down this peak.

It's part of what the Council research is doing, but we're also looking at just the overall effect of the conservation programs that we've got in the memorandum of understanding, and where there's the ability to have these energy tradeoffs.

The MOU now specifies that cost effectiveness, that benchmark of avoided costs is where water agency scales off. So depending upon whether their water is expensive or cheap that dictates the amount of conservation they do.

Typically that doesn't include this

embedded value of energy. And that's an issue that we really are very interested in exploring with you.

As I mentioned, we're doing this study with Lawrence Berkeley Labs on the environmental benefits. We're also doing, as the same sort of meshed piece of it, an avoided cost study, together with the American Waterworks Association Research Foundation. We've contributed money to get a very simple methodology where in a spreadsheet water agencies were all calculated the same way.

One of the hassles in my job is that every single water agency does their avoided cost calculation differently. Some just consider the avoided cost of pumping as their only avoided cost. Some have a true avoided cost. If they had to go out and get that next increment of supply by building a supply project, what would that be. So there are wildly fluctuations of definitions of it, and we're going to try and standardize that. Gary Wolff is working with us on that, as well. So we have a lot of the same partners that you've been hearing from today on this project.

We also have this statewide savings

model in our reporting database. We're refining that, and I think that also can be of help in defining the savings. We need to further refine it with respect to the energy usage.

And we did some research work during the 2001 energy crisis that I just want to share with you. Because I think the work that we did there began to get us, at least, to think about what some of the issues are.

This is a slide that's very duplicative of everything you've heard today, but there's a real water/energy connection in California, the long distance, the elevations, the pumping and the treatment, geographical variation in water sources, et cetera. Different treatment requirements for the water, that's also a big energy issue.

And we feel really strongly that energy has to be considered, not only from the source, but all the way to the end of the treated discharge. So I was happy to hear that you're going to be considering the wastewater component in this next phase of your project. Because the wastewater treatment costs and energy usage are very significant and need to be considered as part of that overall chain.

You know, if we're saying water is 7 percent of California's energy load, that's not really true if you do it all the way to the end. It's much higher. And I'd love to see what that number is.

You've seen this chart. Bob had it up. I really want to add conservation into this chart somewhere, but I think that's part of the work that we need to do together.

This is a chart that Bob also showed you. I wanted to put this up because I think municipalities aren't really sure of -- aren't aware of how much of their municipal expenditures go towards energy for water. And what we need to convince municipalities, as well as water supply agencies, is that there are a number of things that can be done to do that.

Water conservation can reduce your water pumping and your treatment costs. And that reduces the energy. It can yield energy benefits at a very cost effective rate. Historically we've not looked at this tie as much as we should, and these hearings, I think, are going to do that. And it's an opportunity for a lot of agencies to have partnerships together, which historically we haven't had until recently.

Here are some sample estimate programs that we put together in 2001 when Governor Davis was asking for proposals at the Legislature. None of these, of course, were funded. But I thought I would put it up there just because it's an indication of the kind of work we tried to do at that point in time.

We came up with a clothes washer program with a financial incentive of $300 a machine. We figured 140,000 machines, $40 million total for the incentive, would give you over 13,000 megawatts of capacity. Clothes washers on the commercial side, even if you only did 6000 machines, would give you almost 1500 megawatts of capacity.

And commercial dishwashers are a real unexplored area for us. We're still doing research on this. East Bay MUD, I think, is doing a study of this, as well. If you did as much as $2700 rebate on a machine -- and they're very expensive, they're about $15,000 -- and you only did 500 machines, you'd get huge amounts of savings of water and energy. So these are the kinds of things we'd like to work on and perhaps cost out in a more precise way.

Cost effectiveness. In California in 2001, you guys all know this, you were buying much more expensive energy. Conservation can yield you energy at roughly half of what we were paying at that point in time.

I want to comment a little bit in the time remaining on the energy down the drain report, because I thought this was a very significant effort that helped focus attention on the water/energy issue.

We agree with the conclusions that water conservation lowers energy use and energy bills. That recycling is a very energy efficient water source. The conservation pricing could give a lot better signal to the customer if it were more widely implemented.

And I just want to raise the issue about dams, that they also produce power as well as consume water downstream. And so if you're going to divert water above the dams, it is costing you energy and money.

As followup issues I want to ask that the Commission continue to further measure the embedded energy costs in water. I think there's a lot more work we can do there. Factor in the production, as well as the consumption.

Gary mentioned the water-to-air model that Pacific Institute has put together. We have posted that on our website, as well. We're asking all of the water agencies to test the results that they -- to serve as their own little case studies. And we want to share information about what everyone is finding so that that model can be further tuned.

And we want to make sure that in your considerations that we factor in the environmental benefits work that we're also doing. We're happy to share that. We feel that a lot of that is going to be embedded in the avoided cost numbers that we will be producing. And energy is a very clear part of that.

And we agree, also, with the recommendation in the report that water measurement needs to be improved. Energy has got a terrific database of information that we don't have the equivalent amount of in water, because we have not been as precise about measuring those increments the way they have in energy.

And so I really look forward to talking with everyone about how to not only improve the measurement, but enact measuring devices like time-of-use metering that will help us improve the data gathering.

Funding is a big issue. Many conservation programs are not done without incentive funding because sometimes the cost of the conservation program is above the local avoided cost value.

Proposition 50 has just solicited $30 million worth of proposals from the agricultural and water supply community. It's my understanding they've received over 200 applications for that money. And right now there's no priority for programs that provide extra water/energy value.

One of those applications from Lawrence Berkeley Labs, we were a partner on, that would investigate the benefits of improved hot water delivery systems within residences and other buildings. That's an important research effort that I hope is funded.

We also partnered with East Bay Municipal Utility District on a water labeling program initiative, WaterStar, like an EnergyStar program, a WaterStar program.

So these are the kinds of proposals that are being suggested. But there are also implementation programs. And to the extent that the programs are delivering hot water savings or peak time savings, they have an energy value, they should get extra points for that. Right now that doesn't exist in the funding criteria.

There also should be better shared funding strategies with the energy community. When I was in Metropolitan in the early '90s we worked with the energy agencies, SoCal Edison and SoCalGas on something called the water/energy partnership, where they actually contributed parts of the rebate costs that were scaled off of their avoided cost of energy.

And that program folded. It doesn't really exist anymore. And the partnerships that we could have with the energy community are not there.

The CPUC funding that we have for our spray valve program is funding directly from the public goods benefit charge, and we got, you know, sort of serious resentment from the energy community who said that's our money that now is going to the third parties; we should have been doing that program.

The point is they weren't doing that program. And I think there needs to be greater understanding of what that money is being used for and how we can maximize the water/energy delivery potential from those funds.

And I think we should research and develop more opportunities. The spray valves, gosh, we didn't even know about them three years ago, four years ago. The technology is moving so quickly it's really important that we collectively take a look at what can be done.

We've been working very closely with you on your AB-970 standards setting process. We've testified on your commercial clothes washer standards, residential clothes washer standards. We're working with you on your DOE waiver application. We testified on the spray value standards and tub spout diverters. Anytime you do anything with water, you know, we show up and wave the flag and bring water agencies to support it.

We work with Flex-Your-Power. We help them with giving -- we've created with them a rebate database on the Flex-Your-Power site. We do a lot of joint public marketing. One of those Prop 50 applications is with Flex-Your-Power to do a statewide marketing campaign on the water/energy benefits.

So we're really very very interested in this issue. And welcome the opportunity to work with you further. Which brings up the issue of a memorandum of understanding, which we have put together a draft on. And we're floating it within your internal bureaucracy at the moment.

And this memorandum between our two organizations would officially recognize the joint efforts, and would formalize the connection that we have, would leverage the funding that we have and the funding that you have. And would give us the opportunity to do a number of research items which, given the time, I won't read. But there are copies out there for everybody.

And on page 3 or 4 of the MOU there's a whole list of nine projects that we think we could productively work on together.

One of those is hot water design. I'm really fired up about this one. This one is one the CEC has looked at quite a bit and has done some very leading work in the field. And we think this work needs to be expanded. That's why there's this Prop 50 application that Lawrence Berkeley Labs has put in. But there's also the opportunity, and this is something we'd like to do just independently, to develop some standards for the building community on how these systems could be put in houses now.

We're building 100,000 houses a year in California. And those houses are much much worse than the houses that we built in the '40s and the '50s. And Gary can give you, you know, chapter and verse on the wastage that's occurring. We need to deal with this now in such a way that perhaps we could, either through your code setting, or through some sort of incentive programs, begin to encourage developers to recognize the hot water wastage issue in their design plans for these homes. And just deal with it right from the start. Retrofitting it is going to be exceedingly expensive. We need to just get them to build it right to start with. And I'd love to work with you on that kind of a project.

We even put in a Prop 50 application for a green building kind of a standard-setting process that would specifically focus on those undone water pieces like outdoor landscaping and hot water usage. And so if that's funded then we would look forward to sharing that with you.

But I think we need to sit down and talk more with the U.S. Green Building Council. Their LEED program is just appalling in how little it really considers water and how little it considers that water/energy connection. And so we need to improve on that. We have a representative from the Council that chairs the water subcommittee. So we're hoping for some movement there. But we'd like to work with you and with the development community to perhaps improve that.

This is a picture of an award we got from Flex-Your-Power, you know. And then here's our website URL. And we encourage you to take a look and check out what we've done to date. The reporting statistics and the conservation programs are all publicly viewable. You just click into the reporting part of the website and it takes you to the publicly viewable reports.

And I'd be happy to provide you with any additional information from our database that you feel would be relevant or important.

And I thank you again for the

opportunity to speak to you.

PRESIDING MEMBER GEESMAN: Thank you for a very comprehensive presentation. Commissioner Boyd and I will follow up on that MOU and make certain that our staff addresses it in a timely way.

I do have a couple of questions.

MS. DICKINSON: Um-hum.

PRESIDING MEMBER GEESMAN: When do you expect the avoided cost and environmental benefit study to start producing interim reports or draft reports that would be available to the public?

MS. DICKINSON: The study is projected to be completed by December of 2005, so this year. That's our funding timeline. We've already received funding from the Bureau of Reclamation and EPA to finish it.

So I would say you would have usable information probably by this summer in a draft form.

PRESIDING MEMBER GEESMAN: Okay.

MS. DICKINSON: And the final study by the end of the year.

PRESIDING MEMBER GEESMAN: Okay. That may be very helpful to us.

Secondly, you indicated that conservation pricing was one of the best management practices identified in the MOU, or memorandum of agreement, I guess. How prescriptive is that particular best management practice?

MS. DICKINSON: Well, it lists different types of rate structures that would comply, so a water agency that just adopted seasonal rates would technically comply. It doesn't mandate inclining block, --

PRESIDING MEMBER GEESMAN: Okay.

MS. DICKINSON: -- however, there are a number of agencies that have already done that. We just did a search of our database and found that there are 64 water agencies in California that have inclining block rate structures.

Now 64 out of a field of 450 is not really very good. There are roughly 450, 460 water agencies that serve over 3000 acrefeet or 3000 connections. So that's really -- you're not talking about the little guys. You don't want to go after the mutual companies that serve trailer parks. You want, you know, the big folks.

And so we have some work we need to do.

The water community is taking a look at it. The environmental side of our Council is pushing hard for us to revise that practice to make it more prescriptive. It's a very sensitive political issue, but it's very clear that it does produce savings.

And, again, one of the Prop 50 applications that we submitted was to actually do an empirical study of those inclining block structures and what they produce. So if that got funded, then we would have a piece of research to also share with you.

PRESIDING MEMBER GEESMAN: With respect to the cost effectiveness requirement for conservation measures, are districts allowed, under the memorandum of agreement, to trade back and forth?

MS. DICKINSON: No.

PRESIDING MEMBER GEESMAN: Okay.

MS. DICKINSON: Each retailer is required to comply with the 14 practices, or to show if it's not all 14, why it's not all 14. And so there is an exemption process if they're not cost effective. And they have to actually file documentation explaining why they're not doing a practice. It's an individual retailer-by-retailer responsibility.

Under the certification program that's being discussed by CalFed, the California Bay Delta Authority, there is some talk about aggregating by regions under wholesaler umbrellas. At this point I don't know how that's going to be resolved.

PRESIDING MEMBER GEESMAN: And that would presumably, say within the Met, allow a district that had a $100 an acrefoot opportunity, and a neighbor that had a $75 an acrefoot opportunity to allow the first district to gain credit for purchasing conservation from the second district?

MS. DICKINSON: Well, I don't know if they'd be purchasing conservation or just relying on them to just bring the regional numbers up. I think that's a real concern to some of the agencies in the north that don't have that same wholesaler structure. They want to make sure that every retailer pulls their weight.

And I think that's the basic presumption under the memorandum of understanding is that every retail water supplier is committing to providing the most cost effective water possible, which means that conserved water should be one of the first areas considered.

And that's what I -- when I said we went to this evolution from just short-term drought relief now to an economic value. Now I think a lot of the agencies are in that mindset where they start to economically price out their options on a cost per acrefoot basis.

And it's now really becoming part of their planning process in a way it wasn't before. We're on a very slow curve toward improving all the numbers statewide. But that's the basic premise. If conservation yields you water at a cheaper cost per acrefoot than you can get it elsewhere, then you need to do it.

PRESIDING MEMBER GEESMAN: Thank you very much.

MS. DICKINSON: Thank you.

MR. TRASK: I'd like to take this opportunity to introduce the one staff member that wasn't here this morning, Gary Klein, our resident expert on water end use. And his name and contact information is at the end of our presentation, so if anybody has any questions on those areas.

PRESIDING MEMBER GEESMAN: But I would caution you that Mr. Klein's coming to work in my office on Monday morning, so --

(Laughter.)

MR. TRASK: Disregard what I just said.

PRESIDING MEMBER GEESMAN: -- his role will evolve. He'll stay involved in this area, though.

MR. TRASK: Very good. I'd like to take a moment here. We have an announcement from Ed Mainland, who's talking about an upcoming conference.

MR. MAINLAND: Mr. Chairman, I'm Ed Mainland from Sustainable Marin in Marin County. And just a brief meeting announcement.

On March 4th, that's Friday evening, March 4th, in Marin we're going to have a large townhall meeting devoted to the nexus of energy and water. And we're trying to present a vision of some of the realities you've been dealing with here today.

And we're trying to translate to the local level and the regional level how our local officials, our local agencies can best deal with what's coming.

And to hopefully move the community, as a whole, in support of moving to another level, a higher level on energy and water conservation.

The meeting will feature Robert F. Kennedy, Jr., and a number of other notables.

So that details can be found on www.sustainablemarin.org. And I'd just like to invite you and everybody within reach of this microphone if they're in the area they're welcome to come.

Also, interesting sidelight, the Marin Municipal Water District has become the first water agency that I know of to join the Cities for Climate Protection Program of ICLEI, that's the International Council for Local Environmental Initiatives.

What they do is inventory the greenhouse gas emissions arising from all their operations. And then they devise an action plan to reduce those emissions. So this might be of interest to other water agencies within reach of our voice.

Thank you.

PRESIDING MEMBER GEESMAN: Thank you very much for that announcement.

MR. TRASK: Our next speaker is Dr. Bob

Goldstein with the Electric Power Research Institute. He'll be talking about what's going on in the electricity sector and research on water conservation.

DR. GOLDSTEIN: It's been a very long week, and it's been a long day, so I'll try to make my presentation as succinct as possible.

My coauthor on this presentation is my colleague, Kent Zammit, who is sitting back there. Kent and I have been working on this energy/water sustainability problem now for five to seven years or so.

Kent focuses on technology, on increasing water use efficiency by building new, advanced cooling technologies, developing, creating and testing. And also utilizing degraded water sources.

My own focus tends to be on watershed management, watershed analysis, hydrology, biogeochemical cycling, et cetera, and also ecological endpoints and ecological impacts.

We've heard a lot today. I don't know that I have anything more to add to what we've already heard. Basically more and more pressure is being put on our water resources. This is being driven by increases in population and increases in development.

Our economy, our social infrastructure and economic infrastructure depend upon the availability of fresh clean water at a reasonable price -- reasonable is somewhat subjective.

What does this entail? Well, we also heard today that there probably is no area within the country, certainly not within the State of California, that isn't vulnerable to a shortage in water availability.

What this means as we go into the future we're going to have to more intensively manage our water resources. We're going to need new technologies. We're going to need further scientific understanding. We're going to need increased research.

The way this will be handled, I guess there's one thing I don't think that's been brought out before. These new, this more intensive management, the decisions that go into it are not likely to be unilateral. They're not likely to be made simply by a government agency with no interaction with the stakeholders.

Nor are they likely to be made

bilaterally where an individual stakeholder group negotiates with a government agency. But the decisionmaking process is more likely to be multi-lateral, and it will include representation from all major stakeholders that have an interest in that water resource.

In addition, the multiplicity of governmental agencies, both federal, state and local, that also have overlapping jurisdictions. So this is also a new feature, the more intensive management, and also going to a multi-lateral decisionmaking type of system.

Energy, as we've heard also, is a water availability, water sustainability is intricately connected to energy. Energy sustainability depends upon water. Water sustainability depends upon energy. They're integrally linked, and their planning and management will have to be coordinated.

Now, Ben Franklin, who was probably the greatest American philosopher of the 18th century, recognized the value of water and pointed out that the value -- we certainly become well aware of the value as the well runs dry.

I don't know if he was the greatest

American philosopher of the 19th century, but certainly he was in the top five. That's Mark Twain. And he also considered water. But Mark Twain spent some time living in California, so he had a California slant to the problem. Said that whiskey is for drinking, but water's for fighting over.

When I was in my early teens I decided that it was probably -- or I probably should broaden my reading of fiction. Up until that time I only read science fiction. And one of the authors I decided to read was Hemingway. And I picked out "For Whom the Bell Tolls". And in the front matter to the book "For Whom the Bell Tolls" there's a quotation or an excerpt from one of the meditations of John Donne because the title "For Whom the Bell Tolls" comes from this particular meditation.

And I was overwhelmed by the poetic imagery of John Donne. Unfortunately, Hemingway was not an equivalent writer, and I don't really remember much of the book, but I do remember John Donne. And I do remember the theme of the meditation which was no man is an island. And, of course, he meant this in a spiritual sense, but because I'm a scientist I'll take the imagery and put it into a material world, not into a spiritual world.

And say, the reason no man is an island is because water is not a barrier, water is a connector. Water connects men, it connects all facets of our society, it connects all elements of our economy. It's the glue that holds our current economic structure and our social structure together, as does electricity.

In 2002 most of the United States was in a drought. Since then there's been a lot of precipitation on the eastern coast and that's been relaxed, although the drought in the west still continues. Here's a recent picture of Lake Mead on this slide.

As was stated before actually you don't need a drought condition anymore within this country to have a shortage of water availability. The survey by the GAO which was taken last year, or at least was published last year, taken the year before, certainly demonstrates this.

Here's a picture of the United States in September 7, 2004. You can see most of the west is in drought. This has been referred to before as a long multiyear drought. As my friends who work for the Salt River Project in Phoenix like to say, we're in the eighth year of a six-year drought.

The significance of the six-year drought is because that's the planning horizon that most agencies use in terms of planning for a response to a long drought. But as we know from tree-ring data droughts can last for decades in the west.

At EPRI we did an analysis looking at water sustainability. We defined a water sustainability index based on the demand for water of the various economic sectors; also based on climatic data. And we projected this to 2025 driven by growth in population.

Now, as you can see, the most highly susceptible -- and this is done on a county-by-county basis -- you can see the most highly susceptible areas are in the magenta, then come the red. And you can see a lot of the areas where there are a lot of counties within California are listed as being sustainable, having water -- being highly susceptible to problems with respect to water supply sustainability.

We also calculated an index which we

called the thermoelectric cooling constrained index, in which we looked at projected growth going to 2025 with respect to electricity generation within the various counties. We got this information from the Department of Energy. We compared it to the sustainability data. And, again, you can see that this would indicate that there is a tremendous, in the year 2025, under a business-as-usual scenario, BAU, that within the State of California there will be a tremendous constraint on the ability to use water for thermoelectric cooling.

I sort of made these points before about why water is a critical resource. The water availability certainly impacts generation. Thermoelectric plants need water for cooling. But it also impacts demand for electricity because it affects the societal and economic infrastructure and the entire economy. And it also affects the electric grid topology because the water determines where the generation plants are going to go, and therefore it determines how the electric grid topology is going to look like.

One should say that another reason for the growing demand on water resources is the increase in environmental sensitivity with the increase in social sensitivity, with respect to environmental conditions, and the greater desire upon society to take actions to take actions to protect the environment and to enhance the environment.

So environmental protection, itself, creates a new demand for water. And therefore, limits the amount of water that can be distributed amongst all -- well, it doesn't limit the amount, but it increases greater competition for the water that's available.

We haven't factored into global climate. It's uncertain, as Bob Wilkinson says, what the exact changes for global climate would be, but clearly one has to be sensitive too, if the climate changes, how this also will impact water and electricity sustainability.

Within EPRI we've started doing research for now for about at least a half a decade; we've had a water resources sustainability initiative underway. It involves both science and technological research. The need for that was well put forth by Robin in her presentation. It includes studying not only hydrology and biogeochemical cycling within watersheds, an ecological response to various water levels. It also looks into developing advanced cooling technologies and technologies to increase the use of degraded waters.

We also look at the integration of micro and macro approaches. The micro approach is looking at an individual facility, be it a farm, be it a residence, be it a power plant, and have to increase water efficiency use within those individual facilities.

The macro approach looks at things at a watershed scale. And one recognizes that there are limited resources that one could invest into both managing one's water and electricity, and how to best distribute those resources across the watershed so you'd get the greatest return for the amount invested with respect to the community investment.

Water is a shared resource, and people, all segments, all stakeholders have to come together and develop a plan exactly how they're going to share that resource.

We believe very strongly in public/ private partnerships. We've worked very closely with the national laboratories. We've worked closely with the CEC PIER program which funded and worked with us on a number of projects. We've got funding from the USDOE. And in all these research projects we try to bring in member power companies, as well. So it's a public/private enterprise, or public/private partnership.

I would like to -- I guess Joe O'Hagan was here before. I don't know where he is now. But I would like to -- we have worked closely with Joe O'Hagan and Kelly Birkinshaw, and I'd like to compliment them for their vision and leadership in this entire area.

Here's a list of reports that we've produced starting in 2002. As I pointed out, some of them were done with CEC PIER program funding, and they were copublished with the PIER program. Most of our research is focused on the need of water for energy sustainability, but we are interested in the need of energy for water sustainability. And we did do one report, that's the volume four of the water and sustainability U.S. electricity consumption for water supply and treatment.

In the State of New Mexico we developed

a program with the Los Alamos National Laboratory Public Service Company of New Mexico to look at -- the objective of this program was by the year 2010 that there would be no net increase in water usage for electric generation within the state.

And this program focused on a particular watershed in the State of New Mexico, the San Juan Basin. I should say the State of New Mexico is actually in the negative water balance. The San Juan Basin actually is connected to the State of California. The San Juan River is the largest tributary to the Colorado. It terminates in Lake Powell. I'll show you a map of that soon.

But the San Juan Generation Station uses 22,000 acrefeet of water every year, taken from the San Juan River. Over the last several years there's been drought conditions within the state. The water's at its lowest levels ever. And there's a need to, if you're going to sustain growth and development, which people want to do, and also the oil and gas industry is being reinvigorated in that particular area, you know, how can you do that. How can you supply both your -- meet both your energy demands and your electricity demands.

This particular slide shows a picture of the San Juan River, the San Juan Generating Plant. In the lower corner here you see a map of the watershed. It's an extremely large watershed. It's about 24,000 square miles. It lies in four states. The San Juan River originates in southern Colorado, flows south, then turns west and goes through New Mexico and winds up, again, in Utah at Lake Powell.

The work that we're doing has two facets to it now. One is looking at the wet surface air cooler, which is a technology to increase the water use efficiency and also the efficiency of dry cooling. And we're testing it actually at the particular plant site. It uses degraded water, water from -- produced water. Degraded water, it's called produced water; it's water that's produced in connection with the development of oil and gas fields.

The other part of the project is developing a decision support system. It's based on a GIS system. It's a model of biogeochemical cycling and hydrologic cycling. And it's being applied to the basin with respect or in conjunction with all of the stakeholders. We feed in all the various water supplies and all the various water demands. And you could look at various, compare alternate management strategies.

The point I wanted to make before, and this illustrates it. It's the large number of stakeholders that one's dealing with in any given watershed. When one talks about managing the water system.

And here are the list of the stakeholders in the San Juan Basin. You can see they include a number of government agencies, a number of different Indian tribes. They include industrial use. There's agriculture; then there's sports fishermen; and then the endangered fish, themselves. And here's one of them, the razorback sucker.

But look at all those federal agencies that have overlapping responsibility for water management or for the water resources within that particular area. There are just a lot of people that have to be brought to the table and have to work together. Not every group can get everything they want. There has to be a give and take; there has to be a compromise. And that's why unilateral or bilateral negotiations really don't work.

One could even -- here's an interesting thing to consider. An environmentalist from the State of California that was concerned with the razorback sucker, and came to the San Juan Basin in the San Juan watershed. And said, this is an important endangered fish, we should save it. Could be accused and looked at by the locals as a person who's having a conflict of interest. Because the more water that stays within the river to protect the razorback sucker means the more water that ultimately flows downstream and goes to California. It just shows you the various complexities and entanglement of interests involved.

The program is much larger; it has many more features than are actually implemented now. We're simply limited by the amount of funding that was available. There's certainly research that we have intended on conservation and renewables, and that we'd like to do eventually, as well as some of the other things noted in this particular slide.

A program like this provides a template for, or a model for programs that can be applied in other watersheds to look at, how to manage the water or the shared resource on a watershed level, or on a watershed basis.

These are the various types of management questions that can be answered with a decision support system that's being implemented there. It could look at climate change, how climate change would affect long-term water supplies. One could look at how regional growth, which is extremely important, because everybody wants the region to grow, wants the economy to grow, how will regional growth affect hydrology and water quality. How will it affect demand for electricity.

Here's a California watershed. This is the Santa Clara watershed. This is not looking at the issue of water quantity, but looking at the issue of water quality. I always get a kick out of the Santa Clara watershed because I live in Santa Clara County; I live in a valley that's known as the Santa Clara Valley, and I live not far from a city known as Santa Clara -- well, a city that is named Santa Clara.

But I don't live in the Santa Clara watershed. The Santa Clara watershed is 400 miles south of where I live. And there's no Santa Clara

River in the Santa Clara Valley. The Santa Clara River is in the Santa Clara watershed, which is 400 miles south.

Now, EPRI wasn't directly involved in this work, but they did use the same decision support system that I mentioned before that we developed and we're applying in the San Juan basin. And the application in the TMDL analysis actually won an award from the Los Angeles Regional Water Quality Control Board for water quality stewardship. And that was awarded last year.

But the point here again is look at the stakeholder steering committee; look at the complexity of again all the different organizations that one has to deal with. I don't mean that -- I mean that's just the truth. I'm not complaining about that, but that just shows when you go into this you really have to get everybody down at the table and you have to work together, both on the research and in the decision end.

And, again, you have a lot of different government entities, a lot of different local government entities. Each city has its own government. Then there's the county government; the regional government boards, et cetera.

Here's a picture of the watershed, the Santa Clara River flow -- actually it lies in two counties, so you've got two counties involved, Los Angeles and Ventura. The Los Angeles is to the east, the Ventura is to the west. The county divide is pretty close to where I-5 bisects the watershed. The Santa Clara River ultimately enters into the Pacific just in the vicinity of the City of Ventura.

Now what you have happening in this watershed is the part that lies in Los Angeles County is being heavily urbanized. So it has all the stresses associated with a lot of residential development, a lot of urbanization, sewage treatment from the residential developments, and supplying water to the residences.

The other part that lies in Ventura County is still heavily in agriculture and it has the problems associated with agricultural runoff and irrigational use of water, et cetera.

The big problem in the river is nitrogen, both in the form of ammonia, nitrate, nitrite. In the upper watershed, that's the part in Los Angeles County, there's also low dissolved oxygen and organic matter, but that's probably associated with the nitrogen. If you clean up the nitrogen you probably clean up the other problem.

When you deal with nitrogen you have a fantastically complex management situation to deal with. There's so many multiple sources of nitrogen, both point sources and nonpoint sources. And, again, you know, you have finite resources, where do you want to put your controls. Where do you get the most bang for your buck.

Do you want to squeeze the sewage treatment plants if the same amount of money will actually reduce more nitrogen load if you go to best management practices on your farms. So, there are a lot of things to consider.

You can run the model to look at different scenarios. The red line shows your numerical target for ammonia. The blue shows the current situation, so you're clearly violating your water quality criteria. And then you can look at alternative management scenarios, both the green and the orange both meet those requirements. And it's a question then of perhaps cost or other factors.

Anyway, what I'd like to do is, this is my final thought that I'll share with you. The State of California has many institutes, many organizations that have a lot of technical know-how and expertise and research when it cones to water and when it comes to energy. Including, of course, the CEC and its PIER program.

I think it would be beneficial, you know, to consider the development or the creation of a consortium of California research institutes to work on this problem. The power of using the consortium is, I've had experience, of course, not only with my own institute, but working with most of these other parties, is each brings different strengths to the table.

Depending upon who the prime customer is for each of these institutes, they've developed approaches and perspectives which are highly complementary and not duplicative. So these aren't really competitive organizations; these are really organizations that complement one another and deal with different constituencies that, in turn, they can bring to the table.

And therefore I think this is worthy of consideration. Thank you very much. I appreciated attending the meeting, and I certainly enjoyed all of the talks that preceded me.

PRESIDING MEMBER GEESMAN: Thank you for your presentation, Dr. Goldstein. I did have a question on the map that you had regarding thermoelectric cooling constraints. Was that restricted to fresh water? Or did it also treat degraded or reclaimed water in the same categories as potentially being constrained in the future?

DR. GOLDSTEIN: No, that was specifically an analysis that looked at fresh water constraints. It did not consider the use of degraded waters and it did not consider the use of saline waters, either -- the ground saline or coastal.

PRESIDING MEMBER GEESMAN: Okay.

DR. GOLDSTEIN: Clearly in the State of California we have many sources of electricity that use -- many thermoelectric plants that use salt water for cooling.

PRESIDING MEMBER GEESMAN: Yeah, I wasn't as much thinking of that as an effort that the Commission has tried to make increasingly in its siting decisions to require the use of reclaimed water whenever such a source is available.

DR. GOLDSTEIN: Yes, well, one could take that methodology that was applied. As I said, the map that I showed you was for business as usual. One could take that methodology and apply other scenarios and then see how those constraints are removed.

PRESIDING MEMBER GEESMAN: Thank you.

DR. GOLDSTEIN: You're welcome.

MR. TRASK: Thanks, Bob. Our last presentation for the day is from Matt Klein of Verdant Power. And it's going to take us just a moment here to load it up.

(Pause.)

MR. TRASK: We're getting there. By the way, folks listening on the web, we were able to get many of the presentations posted before we started the workshop. Others were not available. So we'll get those posted as soon as we can.

And there will be a transcript of this workshop available on the internet within two weeks, probably shorter than that.

And there we go.

MR. KLEIN: My name is Matt Klein; I'm the Chief Executive Officer of Verdant Power.

We're a free flow hydropower systems developer. First of all, thank you very much for having me today and allowing me to speak with you.

There also are hard copies out on the table, so I can email copies, or as Matt says, they'll be up on the web.

I believe that I'm the only representative here today of a private company, so I want to acknowledge that bias right off the bat. I will do my best to represent this emerging industry, but of course, that bias creeps in.

I'm going to start off a little bit out of order by showing you a short movie presentation. This presentation will be six five-meter-diameter rotor free-flow turbines that are about to be deployed in the East River of New York City. It will be the first distributed generation free flow hydropower project in the world.

I show it first because if a picture is worth 1000 words, then this little movie is worth everything that I will say today.

So, here it is, if it will work. Hopefully it will work. Okay, maybe we'll show it at the end. This is a photograph or a rendition of what you would have seen there. The actual turbines in motion, accurate as to rotational speed, 30 rpms. These are not thousands of rpms like a traditional hydropower turbine or a propeller; the spacing also is accurate as to scale. If we have time I will show that at the end. I have it in a separate file here that I can easily show.

In general, there are five categories of free-flow hydropower turbines. First of all, free-flow hydropower is distinguished from traditional hydropower primarily by not having impoundments of water, not having large civil works, being much more environmentally benign because of those issues. Being easier to install, quicker to install, modular, and often distributed generation. That's something that we'll talk about.

The five general families are cross-flow turbines, meaning that the axis of rotation is perpendicular to the flow of the water. There are lifter flutter vanes that look like a venetian blind. We'll see a copy of those.

Water wheels we're all familiar with, venturi systems. And I've bolded axial flow turbines, very much like underwater windmills is the best visual conceptualization to get here.

And I've bolded it because this is the technology that is being advanced most quickly. It is the farthest along. I think, without going into the scientific explanation there, which I'd be unable to do anyway, anecdotal evidence of 30 years of wind power development. I think there's some reasonable justification for having a windmill-like turbine structure. They've tried every other kind of vertical axis and whirligig type of machine, and the most efficient has proven to be in bench tests and prototype tests and actual commercial usage, the axial flow propeller fan.

The stage of development. There are conceptually, and we know this, and this again will speak to our ability to represent the industry to some degree, the Electric Power Research Institute we just heard from, EPRI, has commissioned us for the last three years running to write their TAG report, their technical assessment guide on the state of the industry for what they call low-impact hydropower, we like to call freeflow. Again the distinguishment being between a dam or impounded or barrage system versus a free-flowing system. We've also done similar work for TVA and other institutions like that.

The concept stage there are at least dozens, who knows how many people are thinking of it, ones that have reached the bench test phase, probably have those. Again, it's difficult to know.

Actual physical prototypes in the water that have worked and worked successfully are about ten, about ten of them have gotten that far. Commercialized systems, zero. We're almost there; we're very close. Verdant Power is within weeks or months of having the first one, but at the moment it's zero, and we'll talk about why and what we can do about that. And why we should do something about that.

Two main distinctions, too, in terms of the technical and business model, distributed generation versus centralized generation. You all know the various attributes and benefits of each of those, so I won't go into that.

Just as quick examples of the different kinds of turbines. This is a cross-flow. What you see here is actually developed by Bosch

Aerospace as an offshoot of the turbine that powers the Osprey Helicopter. It's from the aerospace industry, and water being a fluid just like air, 800 times denser than air, but a fluid nonetheless, the physics are the same, and they're trying to adapt this turbine to water usages, and they're going through Verdant Power as a systems or platform integrator to help them do that.

Flutter vanes, again I described the venetian blind. This is happening in Arnold-Cooper system at the Cooper Union for the Advancement of Arts and Sciences in New York City. It has reached the bench test stage and it's a distributed generation system.

This system is a water wheel from the eighth century A.D. in Ireland. And Verdant power has incorporated it in 2000. This project has been delayed by regulatory issues. We expect to have all the licenses shortly and it should be online in the next couple of months.

Overseas, we're going to make two leaps here. One is in decentralized generation, the other is into overseas applications. And it's not coincidental. That's the case. The resource there often is very deep and very fast water. And that's what they're taking advantage of.

Two companies have reached the prototype stage. One is Marine Current Turbines, whose turbines you see in the top left. And then on the right the other is Hammerfest Stroem in Norway; it's actually producing power into the grid. They still call it precommercial and hopefully it will succeed and keep going.

The issue with these, outside of long transmission lines, is the problems with the centralized model. But what we're all aware of is the very large capital costs, the very difficult environment that they're working in for both deployment and operations and maintenance, as well as the visual pollution. You have a very large structure above the water that makes siting more difficult.

Won't go too much into the market, but various studies done by EIA, the UN, New York University, Natural Resources Council of Canada, in DOE in the lab now have indicated 90 billion-plus global market for installations alone. That's ballparked at $1500 per kilowatt installed. That is, I think, an underestimation by, you know, a factor of ten at least.

There are other usages that I'd like to spend more time on, but that are worth mentioning. The bottom bullet point there, you have water, you have energy, electricity. There's a lot you can do with that. Hydrogen production through electrolysis, water purification, desalinization, irrigation, mechanical pumping without having the loss of transfer of energy from electrical to mechanical to power pump and back into -- sorry, mechanical from the kinetic energy moving water into electrical energy into mechanical to power the pump. You can just go directly to use these turbines for power pumps and irrigate fields in the Central Valley. And especially in third world developing countries, as well.

The important reason why this -- a couple others, too, but one reason why this industry has not taken off yet is because it is populated almost entirely by inventors, scientists, technologists, garage tinkerers, people developing, for lack of a better word, a gizmo, a kinetic hydro energy conversion device or gizmo.

That device is -- we saw examples of at least a half a dozen of them -- it's probably 5 percent of the entire business. The rest of it is financing, permitting and licensing, siting, stakeholder engagements, regulatory issues, stakeholder engagements, et cetera, et cetera. Grid interconnection, power conditioning.

And all these different companies that are building different turbines, different ways of converting the kinetic energy of moving water, again versus the potential energy developed by a head created by a dam or impoundment, a lot of these companies are coming through EPRI and through DOE, and through Verdant Power to help put those different turbines or kinetic energy conversion devices into this platform. The platform being the other 95 percent of the business that I described. And I'll show an actual example of that in a moment.

Getting to, and this again in the interest of full disclosure, it's getting a little more Verdant-centric. This is actual, going to get into, actual projects at this point.

The farthest along in terms of development of any distributed generation free-flow hydropower project in the world is happening in the East River in New York City at the moment.

We have been over two years. In January of 2003 we did a successful prototype demonstration test in the East River at the site that we have a FERC permit for.

Since then we've been developing the commercial system. Ultimately we intend to put up to 300 five-meter diameter rotors rated at 37 kilowatts each, a total potential of 10 megawatts. This is about 35 feet of water at low tide. It is about a mile long, 250 feet wide. It's actually not a river there, it's a tidal basin, so it gets power both ways. The systems have a yaw mechanism where they rotate 180 degrees and capture power both coming and going.

The field that we're taking is one-half of one-half of the East River. The East River at that point is split by Roosevelt Island, which creates a nice natural effect without having to use civil works. Most of the commercial and boat traffic goes on the western channel towards Manhattan. And really the only major usage of the eastern channel, I guess ironically, is barges that carry fossil fuels up to the Keyspan Power Plant at Ravenswood that is directly adjacent to our project site. It's a 2700 megawatt fossil fuel plant; it provides 25 percent of the power to New York City.

New York obviously has an RPS, renewable portfolio standard, to have 25 percent of their power developed from renewables. It represents about an 8 percent increase, because they have a good deal of traditional hydro at the moment.

Mayor Bloomberg also has a goal of having 80 percent of the power consumed in New York produced in New York. So for obvious reasons, for the infrastructure system susceptible to aging and terrorism, as well.

We received so far three half-million-dollar grants from NYSERDA, the New York State Energy Research and Development Authority, for conducting these tests. And we expect continued both financial and in-kind support. We've gotten a great deal of that.

This is one of my favorite pictures. You're looking from the southern tip of Manhattan, I guess from a helicopter. As you look down you see Roosevelt Island directly in front. At the very bottom of the screen in the middle is the UN Building. And you see a tug and barge heading north to south up the western channel of the East

River. Again, illustrating that most of the boat traffic goes that way.

We will be using the far side of Roosevelt Island towards Queens, one-half of that channel. If you can make out three smokestacks in the top slightly right area of the picture there, that is the Keyspan Plant. Again, a 2700 megawatt plant.

Residents of Roosevelt Island here refer to this area as asthma alley. I'm guessing it has something to do with the plant there and the effects of the emissions.

The picture on the left is the actual prototype test that we did in January of '03. We also did it in October in Chesapeake Bay, tow tests behind boats and a custom-made multi-hull platform that you see there. Two of those feet are mine. It was very cold there in January.

That was a very successful test, 3 meter diameter blades, 16 kilowatts, higher than expected. And we took the measurements of power, torque, kilowatts, horsepower, et cetera, that we needed to develop over the last couple of years the commercial system that you see on the right, the rendition of it. That system is complete in design and construction, three of the six of them are complete in construction, and all six would be except that we are not wanting to -- we're pacing with the regulatory issues.

They are sitting there and they're ready to go in the water. We're waiting permits from the Army Corps of Engineers and from the New York Department of Environmental Conservation for a six-turbine test field.

The idea would be to put six turbines in the East River, conduct 18 months of studies on the effect of marine life, migration patterns, cormorants that dive down to get the fish, water quality, et cetera, et cetera. It's a very difficult process that I'll speak more to in just a moment.

Here's another actual test that we did and completed in October of 2004. It was about three months in the Merrimack River just north of Boston, in Amesbury, Massachusetts. The turbine you see on the left there is called the Gorlov Helical turbine, developed by Dr. Alexander Gorlov and Dr. Igor Pauley who have a separate company called GCK Technologies.

And this is one of the -- these are

brilliant scientists; they've developed this helical -- turbine. As you can see, it looks kind of like a strand of DNA. And they have basically everything up to a spinning shaft. And nothing else.

And they recognize, and I think they would be fine with me speaking for them in this way, that that will never get to a commercial stage without a drivetrain and power conditioning and siting and financing and permits and so on and so forth.

So we've teamed up with GCK Technology. We got a half-million dollar grant so far from the Massachusetts Technology Collaborative, Massachusetts Renewable Energy Trust, and we did a prototype demonstration on the Merrimack River, and completed very successfully in the end of October.

On the right you see one of the units being deployed off of a barge into a tidal current there. These can work in uni-directional rivers and streams, as well. It just so happens that the first two major prototype tests have been tidal, and we're lowering the one right there.

These --

PRESIDING MEMBER GEESMAN: What's the size of that turbine?

MR. KLEIN: That turbine is 1.5 meters in diameter, and about 2 meters in length or height, depending on how you want to look at it. Width on the left and height on the right.

PRESIDING MEMBER GEESMAN: And what's its rated capacity?

MR. KLEIN: It depends entirely on the speed. The capacity of this one is about 3 kilowatts. The power, and this is true of the axial flows, as well, and it's true of wind turbines, any fluid flow, increases with the cube of the velocity of the water and the square of the surface area presented to the water. So, obviously small increments in velocity have very large effects on power output.

To try to answer your question more directly, in three knots of current we got about 2.5 kilowatts out of this one. I'm sorry, four knots of current, about 2.5 kilowatts out of this one.

We believe still, as I said earlier, that the most efficient turbine, and this is not a gut feel or an opinion, this is years of bench testing, all the way back to the mid '80s. In fact, the man holding the rope there in the red shirt is Dean Correm, our Director of Technological Development. He invented the rotor that we're using in the East River as a NYU research scientist in the mid '80s. He came back in 2003 after a successful career in politics and business and technology, and saw our demonstration on the East River that we saw pictures of a moment ago. And he was so pleased he joined our company as the Director of Technological Development.

So, again, we believe that the axial flow propeller fan turbine is the most efficient. There are other considerations. We don't have an infinitely deep resource the way that wind has an infinitely, theoretically infinitely high resource.

We also have some mounted horizontally in very shallow water with these, perhaps four feet of water, which dramatically opens up your siting opportunities. There also are fish issues in terms of safety for marine life, and debris fouling, bio-fouling.

We've not yet found evidence that this particular rotor or any of the other cross-flow rotors are any more benign or advantageous in those regards, but we are thoroughly testing all of them.

Moving to California, and I regret that I missed the presentations earlier today, and I imagine a lot of this was covered. I don't need to go into a lot of detail.

But there are a number of issues that overlap water and energy. And we think that we have some very good solutions to those.

Largely the solution, there are uni-directional rivers, of course. There are large tidal opportunities such as the San Francisco Bay. In May of 2000 the San Francisco-- 2002, excuse me, 2002, the San Francisco Board of Supervisors voted to bring on a 1 megawatt tidal power project under the Golden Gate Bridge if they had a million dollars to make that happen.

That is a wonderful idea. The time is not right for it yet to develop anything under the Golden Gate Bridge or in the San Francisco Bay.

The opportunity in California, quite frankly, near term is in manmade channels, aqueducts and irrigation canals. And there are a number of advantages, both as developers and to the State of California, and California ratepayers to being able to do that.

So there are manmade channels; there can be incremental hydro off existing hydro facilities; flood control dams; power plant discharge fumes; water sanitation facilities. There's actually -- this is in North Dakota -- a water cooling tower from a nuclear power plant that has water coming out of it. It's only about a foot and a half deep, but it moves at 12 knots. So you're not going to be a very efficient turbine in there, but at 12 knots you don't care so much.

And as incremental power you could be offsetting retail rates, you could be grandfathering under existing licenses. There are a lot of advantages there, and a listing of just some of the resources that are here in California.

Pictures of some of the resources in California. Some of them are very fast-moving, as you know, and very small. Some are larger, deeper, slower moving. There generally will have uniform geometries; often nice concrete sides and bottoms; makes deployment much easier, much more replicable. And much quick and cheaper for the ultimate clients.

This is just one example of how it might be done. This happens to use a cross-flow axis and kind of a swivel arm that goes into an irrigation canal. It could either be on a spring-loaded, to bump itself up to avoid debris. It could be raised for service or maintenance.

This is just one example of things that we've been working on. There could be cross-flow axes mounted from surface-mounted units. They could be mounted from the bottom, from the sides. A lot of different ways to take advantage of the various attributes of the manmade channels in California.

This is a slide that I borrowed from Dr. Lon House earlier that you may have seen already. The point being the red line, this is a daily chart of power usage from September 8th of 2002, I believe. Showing where the red line is the consumption of power over the State of California. The green line is the generation.

And two important points. One is that you can see where the red line almost touches the green line. It's very near crisis situation. The other is that the green line is much flatter than the red line. And that one of the very large issues is not so much absolute generation and capacity versus need, but timing. Peak shaving and load shifting.

Don't mean to tell you what you already know, but I do want to point out potential solution to that issue. And that is that irrigation districts and water districts are already smart enough to know, and they have tariffs to incent them, and costs and peak times versus offpeak times to incent them. They know that when they pump the power and using an enormous amount of power that they don't do it in peak times.

In fact, -- Dr. House, if you see the bump up at the red line there at the end around 6:00, that was described by Dr. House as the irrigation districts turning on their pumps after peak hours. My point being it's an enormous amount of electricity.

The other half of that, if you were to have free-flow energy devices, turbines in there, in irrigation canals and aqueducts, you could have a lot of release of the water at their discretion and have generation happening during peak hours.

So you really have a pretty, I think,

powerful ability to load shift by moving generation out of peak times and -- excuse me, moving usage out of peak times and moving generation into peak times and really flattening that red curve.

Obviously the first turbine doesn't do anything to those curves, but the first turbine is one step towards it. And, you know, a number of turbines as we achieve scale in California can really affect that curve.

And I think that that's a point that's kind of the Holy Grail in a way, is California already has an enormous battery system, if you will, without having hydrogen highway, without having literal batteries or flywheels or any other form of storage, by pumping water up into holding tanks and controlling the release of it, you essentially have a battery that's already there that can be capitalized on tomorrow.

What are the barriers to this happening. I mentioned earlier that there are a lot of people developing hydro-energy conversion devices and hoping that if they build them people will come to them.

Verdant Power has taken a different

approach. We have our own proprietary technology and team of internal scientists as well as consultants, advisers, people from grants we've received from DOE's Oakridge National Laboratory, as one example.

We are approaching it both as a business and as a technology. Still there are two barriers. One, not surprisingly, is financing. So far we've raised about $7 million, and I think this is very important, how we've gotten there.

I all it a four-corner partnership. Private equity from change under the couch to founders to friends and family to angels to IPO, MNA, follow-on and other sort of esoteric private financial mechanisms. Public grants, incentives and other forms of support. And we've really gotten some fantastic both in-kind and financial support from the NGO foundation community, as well as the academic community.

We've formed a very close relationship with the Cooper Union for the Advancement of Science and Art, which is one of the premiere engineering schools located in New York City. The dean of the engineering school and the founder of the Cooper Union Research Foundation, as well as its executive director, Dr. Jameel Ahmad, has joined as a senior advisor. And has been instrumental in helping us integrate that community.

And that allows us not only to have the obvious benefits, but also federal moneys, for example, tend to flow to nonprofits and academic institutions.

Congressional appropriations and large federal grants. State moneys often will flow to private institutions.

Outside of money, when you're dealing with environmental issues it's good to have NGOs and foundations on your side.

So half of the money raised so far has been either from the principals or from public or NGO grants. And I think that's a pretty significant figure.

Tried not to use the phrase the valley of death for more than one reason. One of them being that it's kind of trite. The other, don't like saying it or being in it. But, the issue here is that you get investors who will invest on a story or an idea, obviously with an expectation of return in IRR and growth of their capital. And those tend to be founders, friends and families, angels, public grants, people who want something in return in addition to the purely economical or financial.

That may be psychic; it may be jobs; infrastructure; economic development; renewable portfolio standard compliance, et cetera, et cetera. The few companies that have achieved successful prototypes have done it through this mechanism.

The valley of death comes between this stage and institutional investors, both capital and project finance investors, possibly strategic partners, they could transcend both categories. Certainly public markets and mergers and acquisition, any kind of real corporate finance.

They want mitigation of risk of technology and regulatory issues primarily. It's a "Catch-22". You need money to get to that phase, and you need to get to that phase to get money. That's the issue that the -- the financing issue that we're facing now.

Project financing is very similar. The innovation often, not always, often comes from public institutions, from the government, from academia or from start-ups like ourselves and like every other free-flow hydropower -- I hesitated for a moment to think of anyone who's established who's working on this in any serious way. Unless it's super-secret and I don't know about it, they're not. They're all start-ups.

None of these groups have the balance sheet for large capital-intensive projects. So that's another issue and barrier that we're facing. And something that we need help with.

Second barrier is regulatory. The current climate in the United States is not designed for innovation. And I feel qualified to say that by having spent two years trying to put in six turbines that we'll remove in 18 months, that we will stop if they kill fish, if they do anything harmful, directly adjacent to a 2700 megawatt fossil fuel facility.

A barge bringing in fuel for one of these plants, one trip, will do more damage to this river than we'll do in ten years. But there is a strong support for incumbency; they are not up for relicensing. We need to get licenses, we have to prove ourselves, they don't.

We've been heavily involved in

stakeholder engagements from private individuals, from FERC, who has been fantastic, from the EPA, DOE, NOAA, National Marine Fisheries Service, Coast Guard, New York Department of Environmental Conservation, et cetera, et cetera.

We did have a meeting some time ago with FERC Chairman Pat Wood, III, who saw what we were doing and realized very quickly that this is not traditional hydropower and there needs to be a different process for it. And he kind of gave us the mandate to go through this process and sort of rewrite the rules and present them to FERC for redesign, which will be fantastic if and when that happens.

The concern, quite frankly, is that it either won't happen in time, or it certainly, at the very least, will slow down the advancement of what can be a very beneficial industry to society at large, and to California.

We would have to do, if we wanted to put a dam in the East River, literally dam it, put a dam in it, dam it, we would have to go through the same process as we do now. We have to go through all the same applications and permits and licenses.

So another effort, and this is one that bring us to California, and myself physically to California, I moved here about six months ago to establish offices in both Los Angeles and in San Francisco because there is a tremendous opportunity here in manmade channels where our mantra is no boats and no fish. It reduces the regulatory issues fantastically. Institutional investor line is a mistake and shouldn't be there.

The other issue in California, of course, is that this is a very progressively minded state. There's strong support both at the grassroots level, and we believe at institutional and public levels, and we're excited to work with the CEC and all the other nonprofit and public institutions here to kind of get this done.

One of our ongoing frustrations is we're on the same team. It's an odd situation to find oneself at odds with fish and wildlife and Department of Environmental Conservation. We are trying to develop a technology that is environmentally benign, that will create jobs, that will create economic development, that will create security, hardened infrastructure for homeland security, reduce the reliance through distributed generation on transportation and distribution grids that are, as we know, aging, fragile and subject to natural and terrorist activity.

This needs to be seen by individuals and/or institutions with expansive thinking and who are in the position to effect positive change. In New York City the way that's literally translating is we have NYSERDA which is one New York agency paying us $1.5 million and spending a lot of time helping us build this process. And the DEC, another New York agency, essentially, through the best of intentions I'll have to say, or I'll have to allow them, basically stopping the process.

So we've had to elevate this to Governor Pataki's Office, which we've been successful in doing. And they've been very supportive. And go to somebody who can kind of see the bigger picture.

I say sometimes only half joking that if we didn't elevate it up to Governor Pataki's Office we'd have to bring it down to the level of the fish and ask them what they want. And if we were able to convene a panel of striped bass I'm pretty sure that they would choose free-flow hydropower.

I'll try to go through this quickly. The idea here again is electricity and water. This is kind of a here-and-now in a hybrid configuration, one of many hybrid configurations. It could be with wind; it could be with solar. This happens to be with a high-pressure electrolyzer.

And the inputs of electricity and water that are readily abundant in situations where our turbines work, of course, go into an electrolyzer, separates the H and the O through electricity, and creates hydrogen which can be used for today for a hydrogen internal combustion engine or fuel cell vehicle.

And then looking into the future, into a more developed grid, storage, transportability, portability, taking what kind of the three levels of quality of power, intermittency that you might get in wind and solar because you don't know when the wind will blow and when the sun will shine.

Free-flow hydropower is the next level of quality. It's very predictable, especially if it's tidal. And it can be forecast in hundreds of years in advance.

The next level, of course, being dispatchable. Especially for peak shaving. This is the way to turn predictable power into dispatchable power.

The way that we're doing this, trying again to get through this valley of death, and one thing that I think that we've recognized needs to be done, and have spent a great deal of effort doing, is creating partnerships through private industry. Above you saw a direct kind of private to private partnership. But private industry, NGO foundations, academic institutions and public institutions.

So here we have the CEC; Natural Step, which is a nonprofit based in San Francisco, one of many that we're very close to. In fact, we have one called Environmental Resources Trust in Washington, D.C. that we were able to get a third-party grant to ERT to fund a position at ERT for a person who works exclusively on joint projects between Verdant Power and ERT. A private institution and a nonprofit.

We also have gotten a grant with ERT from the Gordon Moore Foundation to advance this technology.

Fleshing it out a little bit more, Cooper Union IDO is another design firm based in San Francisco. We've worked with the SF Department of Energy and Rocky Mountain Institute, Amory Levins and his group.

I won't spend a lot of time here. This is very Verdant-centric, but this is the core team that we have, there are about 12 of us full time up from one three years ago. Probably another dozen advisors and consultants that we incent through either appealing to their better nature and/or equity ownership in a private company.

And we've gotten a good deal of grants. I mentioned one from DOE's lab, the Oakridge Lab in Tennessee. It was a $40,000 grant, but more importantly, it came along with two very senior fish biologists who have been just invaluable in dealing with Fish and Wildlife and Army Corps and Department of Environmental Conservation as highly qualified third party, disinterested -- by that I mean unbiased -- experts that have been very helpful to us.

That's me if you need to get ahold of me. There are handouts outside. As we mentioned, we'll circulate this on the web. And I can give you business cards, as well. Please, I'd love to talk to any of you about any opportunities that you might see, or any questions that you might have.

And I thank you again very much for your time.

PRESIDING MEMBER GEESMAN: Thank you, Matt. That was quite interesting.

(Pause.)

MR. TRASK: We're going to try to show the little movie here.

MR. KLEIN: Yeah, -- this is what I was referring to earlier, and I really think it's a great quick illustration. Again, this is accurate as to size, scale, speed of rotation and every other manner.

This is the field, or mini-field of six turbines proposing to put in the East River of New York City. Looks a little more like Aruba, but that is, in fact, the East River.

I think again anecdotally, one can get a very good sense that these are not underwater Cuisinarts that are going to be highly harmful to marine life.

Thank you.

MR. TRASK: Very good. All right, we did have one other speaker, Terry (indiscernible) with the State Water Project Contractors, but he had to cancel. And our program was going to last till about 4:30 with just a brainstorming session here at the end.

I imagine that we're all quite tired, but I will just throw out a few things as far as where we're going to go from here for our study.

We've been talking internally and I think what we'd like to do is establish some more focused groups among the folks, among you folks, and among internal staff to work on separate issues that we've been bringing up here in the whitepaper.

Not everybody is going to be interested in every issue. So what we'll probably do is flesh this out. I'll be working with my counterpart Paul Massera over at DWR and we'll bring this forward in a concept; put it up on the website; and see what we can get as far as interest from you folks in participating.

I did mention that we will have another workshop most likely in March. Of course, it will be up to availability of the Commissioners. There I intend to get really into the meat of these things. I felt that this was somewhat more of an introductory level meeting here; we're all just kind of getting to know the issues. And that one, I think, we'll start to really bear down and really start to work these things out.

So with that, unless there is anybody interested in hanging around for another 20 minutes, I will just throw it open for any general comments, questions. I will urge people to give us written comments. You can send them to my email address which was in the handouts for the presentation. And, of course, it's all over the website.

So, any closing comments from the audience? Yeah.

MR. ROSENBLUM: John Rosenblum, Rosenblum Environmental Engineering. I'm a consultant on energy efficiency in wastewater treatment plants, both municipal and industrial.

One of the things I was listening throughout the day for was this large opportunities in wastewater treatment plants. But more of the connection, Commissioner Geesman, you'd said, how can you trade between water agencies.

Actually, what I see is very large opportunities to trade incentives and cooperative ventures between the water agency and the wastewater agency, where a savings, a reduction in water use, water agency, will translate into reduction in wastewater flow through the wastewater treatment plant.

And usually the energy intensity in the wastewater treatment plant is much larger than the energy intensity of the water supply. So that sometimes there's already the possibility of an incentive for water efficiency, but there's no justification from the price of water that if you include the price of wastewater then it becomes a very economically viable cross-pollination.

And I think since we've been around here for so long that's about all I'd like to say.

PRESIDING MEMBER GEESMAN: Now there are some local agencies in California that have both a water supply and a wastewater function, are there not?

MR. ROSENBLUM: Yes, East Bay MUD. And, again, just as an example, since I know the person who was here, he's on the water side. But it's been very difficult for him to communicate with the wastewater side. Although I've talked to the wastewater side and tried to get them to talk to him.

Sometimes the agencies are so large and the functions, the people are so busy that they don't have the ability to communicate. And that's probably where a program such as you're trying to develop might help a lot.

PRESIDING MEMBER GEESMAN: Um-hum. That's worth further consideration. Thank you.

MR. TRASK: Commissioners, any closing remarks? Or anybody else in the audience?

PRESIDING MEMBER GEESMAN: You know, I'm pretty exhausted, but the one thing I guess I would say is, Matt, I would encourage you to punctuate this effort every 60 days or so over the course of our report cycle with a planned public workshop.

And if, in fact, as you organize topics into specific areas, if it's productive to spin a couple of those off into separate workshops, I'd encourage that as well.

I think we gain a disproportionate

amount of benefit when we open our review process up to a broad group and try and pull in as many comments as possible. Our tendency is to do an awful lot of work effort internally. But just telling you from where I sit, I think there's a disproportionate amount of benefit when we throw this stuff out, even in draft form, to the public.

MR. TRASK: Very good.

COMMISSIONER BOYD: A couple of times today there was reference to CalFed, and there may be a CalFed representative in the audience that I don't know. There is, okay, very good.

I had talked to the Director of CalFed about what it is we're engaged in. And I just, knowing that they were here and listened to all of this, I want to make sure that as we try to incorporate the interests and needs of all multiple state agencies, that they have their opportunity to interface with this. And I'm glad to see that they were here today listening to this. And hopefully we may identify some of these.

I'm very familiar with CalFed from another life, but I'm not sure how deep into them we are as an agency here at the CEC. And they have unique needs and so on and so forth.

So, anyway, it looks like that bridge has been made.

MR. TRASK: Good. All right, well, thanks to everybody for coming on a Friday before a three-day weekend. That's great, great participation. I've learned a lot. Thanks very much.

(Whereupon, at 4:14 p.m., the workshop was adjourned.)

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CERTIFICATE OF REPORTER

I, PETER PETTY, an Electronic Reporter, do hereby certify that I am a disinterested person herein; that I recorded the foregoing California Energy Commission Committee Workshop; that it was thereafter transcribed into typewriting.

I further certify that I am not of counsel or attorney for any of the parties to said workshop, nor in any way interested in outcome of said workshop.

IN WITNESS WHEREOF, I have hereunto set my hand this 23rd day of January, 2005.